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THE NORTHWESTERN ELECTRICAL ASSOCIATION.

The conventions of the Northwestern Electrical Association have come to be recognized as second in importance only to those of the National Electric Light Association. The high quality of the papers presented at past conventions, the earnest and instructive discussions which have followed their reading, and the interest taken in the meetings by the members of the association, foreshadow a large and enthusiastic convention next week.

When the association convenes at La Crosse it will find much matter of interest ready for its consideration. Perhaps the most important subject to which its attention could be directed is that of proper systems of charge for current supply. At the recent Niagara Falls convention of the National Electric Light Association this subject received less attention than its importance merited, although it was discussed at some length. The formulation of a proper system would be a work of the greatest possible benefit to the electric lighting fraternity at large.

In this connection it may be proper to suggest that a modification of the demand-meter system presents the most logical and available solution of the problems connected with an equitable method of charge. The growing favor with which this system is regarded affords designers and inventors an excellent opportunity for the exercise of their talents in producing a demand meter at once simple, inexpensive and reliable.

It is to be hoped that the accumulator will receive, at this convention, the attention that it deserves. European engineers have demonstrated the great advantages of the use of storage batteries in connection with central station systems of supply, but in this country there has been, so far, little enthusiasm for their use displayed. Only recently, and in the largest cities, has there been anything like a proper utilization of accumulators in central station work. Indeed there seems to be almost a prejudice against their use, which is not warranted by the experience of those who have achieved signally successful results through their instrumentality.

The multitude of timely subjects for consideration at a convention of this character prevents even an attempt to indicate them in this place. There can be no doubt, however, that those mentioned above are of prime importance and likely to provoke valuable and instructive discussion.

ANOTHER NIAGARA POWER SCHEME.

In another column is an article by Mr. F. M. F. Cazin, in which a new method of utilizing the water-power at Niagara Falls is briefly indicated. The plan proposed by Mr. Cazin is to utilize to the full the head of nearly 200 feet between the upper extremity of Goat Island and the still water immediately below the American falls by means of impulse wheels, a flume and penstock being constructed in the solid rock between the two points.

This proposition has the merit of entire feasibility, comparatively small first cost for the installation, very high efficiency, and great ease of control as compared with the installations now in operation at Niagara. The pressure wheel has time and again demonstrated its utility and advantages in installations of this character. It

seems, as Mr. Cazin suggests, that the great conservatism which marked the engineering of the Cataract Construction Company's plant led to the adoption of a type of water-wheels by no means the best under the circumstances.

There are certain other advantages to be derived from the use of the impulse wheel which Mr. Cazin did not enumerate. One of the most important among them is the ability to use smaller generators driven at a higher speed, with consequently much less first cost. While efficiency, where the supply of water is practically unlimited, as in this case, is of less concern than in many instances, still the ultimate capacity of any plant constructed at Niagara will be directly dependent upon the efficiency of the water-wheels used. There seems also no reason why the natural head should not be utilized to its fullest extent. It is painful to the engineering sense to see even the unlimited water of Niagara wasted, and no one can doubt that in the present plant of the Niagara Falls Power Company a great proportion of the actual head is wasted, and uselessly wasted.

The project suggested seems so feasible and so comparatively easy of execution that it is to be sincerely hoped that a short time will see it in operation. There has always been a feeling on the part of American engineers that it was not necessary to go abroad to find the best solution of the problems connected with the harnessing of the great cataract. It will be a pleasant sight to witness the operation at Niagara of a distinctively American impulse wheel plant, and to contrast the general operative efficiency of this with that of the foreign turbines now in use there.

IMPROVEMENTS IN INDUCTION COILS.

The study of Röntgen-ray phenomena has caused a diligent study on the part of many experimenters for the improvement of the familiar Ruhmkorff induction coil. The suggestions made by Mr. George T. Hanchett in another column seem so eminently and sensibly practical that it is to be hoped that the directions indicated by him will be closely followed by experimenters interested in this subject. The induction coil, as it has been constructed, is a highly inefficient piece of apparatus. While many improvements have been made upon it recently, there still remains much room for further progress.

ELECTRICITY IN MODERN OFFICE BUILDINGS.

The multiplicity of uses to which the electric current can be put finds no better illustration than in the highly complex structures now being erected in our largest cities for office purposes. An article in this number descriptive of the plant in the new Bowling Green office building in New York City, admirably shows the diversity and extent of electrical applications in these buildings.

In this building we see electricity applied for lighting, for all varieties of signaling, for the distribution of intelligence, and communication from room to room throughout the vast fabric. A building of this character is practically a city within walls, having a population larger than that of many thriving towns. The needs of its inhabitants are of the most varied description, and no agency has yet been discovered that can better adapt itself to a greater number of applications for the satisfaction of these than electricity.

The fine plant in this building is, however, singularly incomplete. While electricity is used for lighting and for many other purposes in a way which reflects the highest credit upon the engineering skill of those having the installation in charge, the now antiquated hydraulic elevator is employed. It seems strange that advantage should not have been taken of the excellent opportunity to install electric elevators, and make the building complete as regards its engineering features. Hydraulic elevators in this structure seem out of place.

SOME NEW USES FOR RÖNTGEN RAYS.

To the daily newspaper the discovery of the Röntgen rays was a godsend. The mysterious radiations that showed the insides of things fired the imagination of their writers, who rushed precipitately into the field of invention and supplemented the labors of the discoverers with columns of lurid descriptions of impossible applications of the strange rays. The public, eager to understand the occult, probably believes the most of what is printed in the newspapers—but some of the recent absurdities in the way of X-ray applications as reported by the press must cause acute mental indigestion to those who believingly read them.

One of latest of these newspaper contributions to science is the grave statement that the custom houses in France have been provided with outfits of Crookes tubes and all the other paraphernalia for the examination of the persons of suspected smugglers. It was stated that this would effectually stop the contraband trade, and that jewelry, etc., though well hidden, could be readily detected; that the cigars in an unopened box could be counted, and that the business of smuggling was forever at an end in those places.

While this is not so bad as some of the statements made earlier in the history of X-ray applications, it is quite as ludicrous as any of them. The most recent story seems to have come from the West, where marvels are common. According to this a California physician accidentally discovered that a radiograph of a piece of gold-bearing quartz exhibited the grains of gold in place, and gave a method of revealing the value of the specimen at a glance, so to speak. The newspaper conclusion is inevitable. Henceforth the vacuum tube and the fluorescent screen, instead of the pick and shovel, will be the prospector's tools. Instead of laboriously drilling and blasting holes through the adamantine mountains, he will look through them. The sledge and drill and dynamite cartridge will give way to the induction coil and battery, and prospecting will become easy.

One of the most entertaining diversions possible, nowadays, for those who know anything about radiographic work, is the reading of newspapers in order to see what new application of the X-rays they will find. It is to be regretted that the fine talent for invention so often displayed in them is not utilized in a more praiseworthy fashion.

Jubilee Honors.

Among the prominent persons invested with knighthood on the occasion of Queen Victoria's jubilee was Professor William Crookes, the eminent English physicist and vice-president of the Royal Society, London. Dr. E. Frankland, who is well known to electrical men as the inventor of a storage-battery plate, also received a like honor.

An Advantage of Municipal Ownership.

It may not be generally known on this side of the Atlantic that the city of Glasgow in Scotland is in the enviable position of being able to pay all expenses of the city government from the revenues derived from its public improvements. It therefore deserves the title of being called the most advanced and best-governed city in the world. Some interesting facts concerning the municipal government of that city will be found in the *Scientific American*, July 3.

A Suggestion for the Construction of Induction Coils.

BY GEORGE T. HANCHETT.

Those who have investigated the construction of induction coils are fully cognizant of the fact that even in its most improved form the induction coil is a most undeveloped piece of apparatus. For this reason the writer trusts that this suggestion may not be unwelcome to all who are working on such constructions, and may find an audience among those whose technical interest is merely general.

It is a well-known fact that if we take two sections of an induction coil, each of which will throw a spark of, say, one inch, and connect them in series, that the resulting spark due to the combined energies of the two coils is liable to have almost any length from two inches up to five. According to Steinmetz's formula, if we have a certain potential resulting in a certain sparking distance through dry air, doubling that potential, as we presumably do by using two sections, should result in a spark more than twice as long. An endeavor to explain why this is seldom, if ever, the result in practice will now be given.

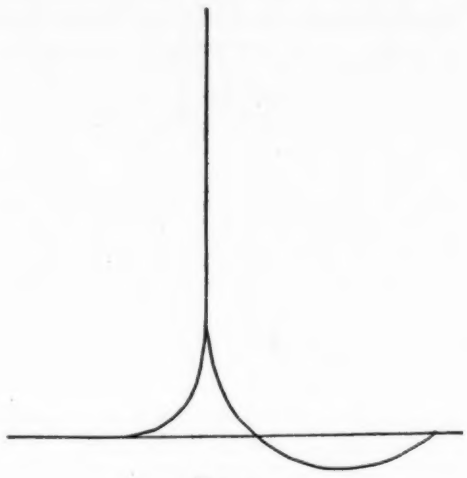


FIG. 1.

If we consider the curve of discharge of an induction coil section, such as is shown in Fig. 1, it will be particularly noted that the maximum potential lasts only for an infinitesimally small time, a hundred-thousandth part of a second or less, so attenuated is the peak representing the impulse of E. M. F., which causes the disruptive discharge. If we add a second section having a similar wave, and connect the two in series, we should have a similar E. M. F. curve with a double maximum, and with this double E. M. F. the spark should be more than twice as long.

Now this being rarely, if ever, the case there is no escape from the conclusion that the resulting maximum E. M. F. is smaller than it should be, and that the waves do not combine in the manner indicated, and from that it is easy to pass to the method by which they, in all probability, do combine, namely, in shifted phase, as shown in Fig. 2, the combination curve being shown in Fig. 3. This is accurate as far as the maxima are concerned, but is slightly widened to avoid confusion in the lines. It will be noted that its maximum is scarcely greater than that of its components, and therefore the case is an extreme one, yet on the arbitrary scale which the writer has assumed in making these diagrams, the shifting in phase is scarcely one-twentieth part of a complete period, which in itself may be easily less than the fifty-thousandth part of a second. It is easy to see that even if the phase shifting were but one-hundredth part of the value used the result would not be materially altered.

An investigation of the magnetic circuit of the induction coil will easily show how such minute differences of phase are possible, and will immediately suggest certain modifications to avoid them. Consider Fig. 4, which is a fair representation of the average induction coil section, the iron core, with its magnetizing coil, being but little longer than the assembled secondary coil surrounding it. The paths of the lines of force resulting from such magnetization have been sketched in dotted lines. In the coil *A*, at the end of the core, there are many leakage lines which cut only the outer turns, and many lines which do not pass through the coil *A* at all. The coil *B*, on the other hand, in the centre of the core, practically surrounds all the lines of force of the primary. Now if the primary circuit is broken and the magnetizing force thus removed, the leakage lines are the first to disappear. It is perfectly reasonable to assume this, for, as the magnetizing force is increased the leakage lines are the last to appear, and there is no reason to suppose that the gradual reduction of the magnetomotive force obtained by breaking a circuit is other than a converse proposition. It is highly improbable, therefore, that the time rates of change for coils at the end and in the middle of this

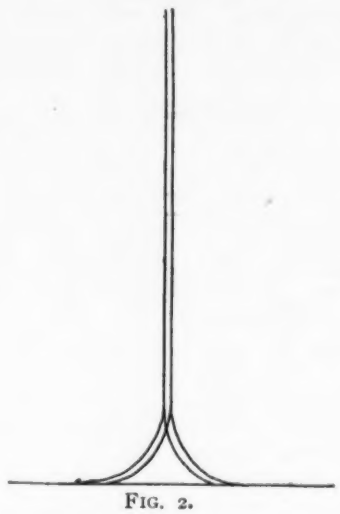


FIG. 2.

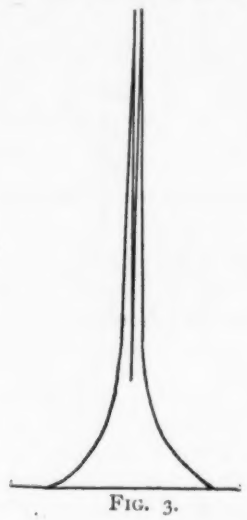


FIG. 3.

induced field are the same, and therefore their maxima of induced E. M. F. are not coincident, and the waves of coils in these different regions will be out of phase with each other, as has just been indicated. An infinitesimal shifting is quite sufficient to produce marked results.

If it were easy to ascertain just what these discrepancies in the field were it would be easy to construct coils with suitable time constants to neutralize this difficulty in a measure, but as the condition of the field can only be estimated, or rather guessed at, the modification of coil windings to fit is also pure guess work. The easiest solution to the problem is a longer core and primary coil, much longer than the assembled secondary, even to the extent of 50 per cent. This allows the secondary sections to work in a more uniform field, and therefore more harmoniously.

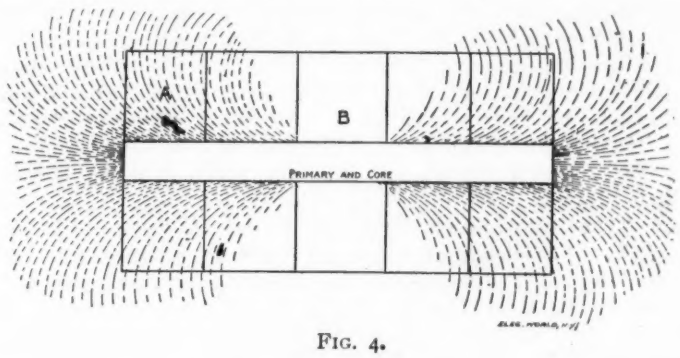


FIG. 4.

A coil built on this principle by the writer has worked notably better than one containing more wire in the secondary, but having a shorter core.

This is diametrically opposed to some principles of induction-coil construction. The rapid demagnetization of a short core, of course, produces a high time rate of change and is very desirable, and it is not easy to say at the present writing just what is the best compromise between these two considerations. Certainly, increasing the core up to 50 per cent. longer than the secondary coil has experimentally demonstrated itself a decided improvement.

Every line of force generated by an induction coil is a closed loop, and if every turn of the secondary includes all of these loops it is obvious that the time rate of change in each section will be the same at the same instant, and the coil will give a maximum sparking distance. From this reasoning it follows that the proper shape of an induction coil secondary is that of the most narrow loop of force as shown in Fig. 5, and this law therefore, dictates that considerably less wire shall be used on the end sections. Very

fortunately this is in entire accord with a practical difficulty of construction. The spacing of the secondary from the primary, if built according to the dictates of the lines of force, will be such that maximum insulation is interposed between primary and secondary at points where the potential difference is greatest. In order to incorporate this principle of insulation into the construction of their coils, many makers have constructed coils with the interiors

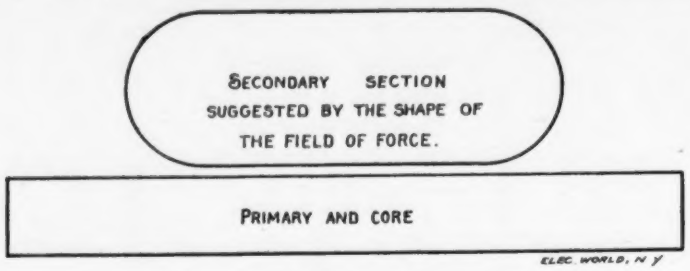


Fig. 5.

hollowed out in precisely this manner, and have obtained superior results by reason of gaining both advantages, but that of harmonious action was one of which they knew not.

A sketch of the field of a primary core by the time-honored method of iron filings should be an approximate guide in shaping the secondary, but inasmuch as the filings only partially succeed in placing themselves along the lines of force it is by no means an accurate one. An exploring coil is better, but is a tedious method. It is, however, to be remembered that a construction once determined and standardized is as easy to manufacture as any other.

The Fourteenth Annual Meeting of the American Institute of Electrical Engineers.

The fourteenth annual meeting of the institute will be held at Greenacre-on-the-Piscataqua, Eliot, Me., on July 26, 27 and 28. The opening session will be held at 2 P. M., on Monday, July 26.

The following papers will be presented: "The Precision of Electrical Engineering." Inaugural address, by the president, Dr. Francis B. Crocker, of New York City. "The Alternating Current Induction Motor," by Charles Proteus Steinmetz, of Schenectady, N. Y. "A New Form of Induction Coil," by Prof. Elihu Thomson, of Lynn, Mass. "Effect of Heat Upon Insulating Materials," by Putnam A. Bates and Walter C. Barnes, of New York City. "The Effect of Armature Inductance Upon the E. M. F. of an Alternator," by Prof. W. E. Goldsborough, of Lafayette, Ind. "Electric Metering from the Station Standpoint," by Caryl D. Haskins, of Boston, Mass. "Development of the Fire Alarm Telegraph," by Adam Bosch, of Newark, N. J. "Electrical Traction; Notes on the Application of Electrical Motive Power to Railway Service, with Illustrations from the Practice of the Metropolitan Elevated Road, of Chicago," by M. H. Gerry, Jr., of Chicago. "The Cost of Steam Power," by Horatio A. Foster, of Buffalo, N. Y. "Efficiency and Life of Carbons in Enclosed Arc Lamps," by W. H. Freedman, of New York City. "Armature Reactions in a Rotary Transformer," by Prof. Robert B. Owens, of Lincoln, Neb. "Recent Applications of Storage Batteries to Electric Railways," by Herbert Lloyd, of Philadelphia. "The Economy and Utility of Electrical Cooking Apparatus," by Prof. J. P. Jackson, of State College, Pa.

Greenacre, the location selected by the Executive Committee for the fourteenth general meeting, is a quiet summer resort in the town of Eliot, Me., and is beautifully situated on the Piscataqua River, about 4 miles above Portsmouth, N. H. There are facilities for boating and bathing. Members should carry bathing suits. If the weather is favorable the roads will be fair for bicycling. Greenacre may be most conveniently reached by steam launch leaving Portsmouth at 11:25 A. M., shortly after arrival of the 9 A. M. express from Boston on the Boston & Maine Railroad. Single fare from Boston, $1.60. Excursion by launch, 40 cents. No special arrangements for transportation have been made, but members are requested to specify the route by which they will reach Boston.

A less direct route, but one which offers the attraction of a short sea voyage, is that of the Maine Steamship Company, whose steamers leave New York for Portland every week day at 5 P. M. Time to Portland (40 miles from Portsmouth) twenty to twenty-four hours. Fare, $5; excursion, $8; rooms, $2 to $5. Meals, 75 cents. Fare from Portland to Portsmouth, $1.50. Staterooms must be secured at least one week in advance.

Members will be provided with rooms at cottages on the grounds, or dwellings in the vicinity; or, if they prefer, may secure tents in the Sunset Camp. Price, $1.50 per day, or $8 per week, with meals at the Greenacre Inn.

Members may also secure rooms upon application to the secretary, at the Rockingham, Portsmouth, N. H., $4 per day, or the Wentworth, at New Castle, N. H., $4.50 per day, American plan. Either of these hotels is accessible by steam launch from Greenacre. Ladies may be invited to the meeting.

Booklets, giving further information, will be mailed by the secretary upon application to those who wish to learn additional details before perfecting their plans.

The sessions will be held at Eirenion Hall on the grounds. There will be a reception Tuesday evening, July 27; evening dress optional. On Thursday, the 29th, there will be an excursion to the Isle of Shoals.

The National Electrical Code.

The long-desired uniformity in the Code of Rules for Electrical Installations would seem to have now become an accomplished fact, as the new edition of the Rules of the National Board of Fire Underwriters, as recommended by the Underwriters' National Electric Association, which is just from the press, is identical with that which has received the unanimous approval of the code committee of the National Conference on Standard Electrical Rules, who have referred it to the various delegates in the conference, with recommendation that they report it to their respective organizations for adoption or approval.

These rules received the approval of the National Electric Light Association at its meeting at Niagara Falls, held June 8 of the present year, and will, undoubtedly, receive the approval of the other associations represented in the National Conference; so that now for the first time a "National Electrical Code" is issued. stamped with the approval not only of the insurance interests, but also of the national societies of electrical, architectural and allied interests.

In the joint meetings between the Code Committee of the National Conference and the Electrical Committee of the Underwriters' National Electric Association the utmost harmony has prevailed, and suggestions from either have been most courteously considered by the other. If the Underwriters' National Electric Association had not been formed for the purpose of uniting the many independent underwriters' organizations, and had it not been for their ready and cheerful co-operation, it is probable that the National Conference could not have brought about the result for which they were working.

As matters now stand the conference has accomplished its work, and has adjourned. The organization remains, and the work that it has done stands as a precedent, so that, should occasion ever again demand, the machinery could be easily put into motion.

It is recognized that from time to time changes in the rules will have to be made to meet the natural growth in electrical lines; it is, however, felt that considering the very satisfactory results now secured, and the slight changes needed in all probability for several years to come, the Underwriters' National Electric Association is the most available body to charge with this work of revision, for the immediate present.

Electrically Welded Barrels.

The Barrbeat-Stange patent barrel syndicate, says *Engineering*, has developed an interesting process for the manufacture of barrels out of steel sheets. A longitudinal seam is welded electrically by the Bernados process. The bent sheet is clamped with its two opposing edges some quarter or three-eighths of an inch apart; a small fragment of steel is placed over the opening by one man and welded by means of the electric arc, while another man stands by to hammer it as soon as it is ready. After welding on successive fragments in the manner named the whole joint is finally completed and the cast is finished by adding its heads and its bung bosses, which are also welded on electrically. Coppered carbons are used except in corners, where plain carbons are employed.

Methods of Testing the Insulation and Resistance of Street Railway Lines.

BY FRANK B. PORTER.

The most important points in the construction and operation of electric street railways are the maintenance of the insulation of feeders and trolley in a high state of perfection, and keeping the resistance of the conductor supplying current to the motors, and also that of the rail return, as low as practicable. Leakage of current, due to defective insulation, if of small importance at first, usually develops in time into serious short circuits, causing a delay in travel on the system while repairs are being made. A high-resistance circuit implies a waste of energy at the power station, lower efficiency in operation and the greater consumption of fuel to obtain the necessary power for the operation of the cars on the line. In this article will be described as simple as possible some of the tests usually employed by street railway electricians for determining the resistance of the insulation and the resistance of the conducting circuits of their lines. These tests should be made systematically at regular and frequent intervals. Any deterioration will then be readily observed, and may be more easily repaired than if neglected and allowed to become considerable and widespread.

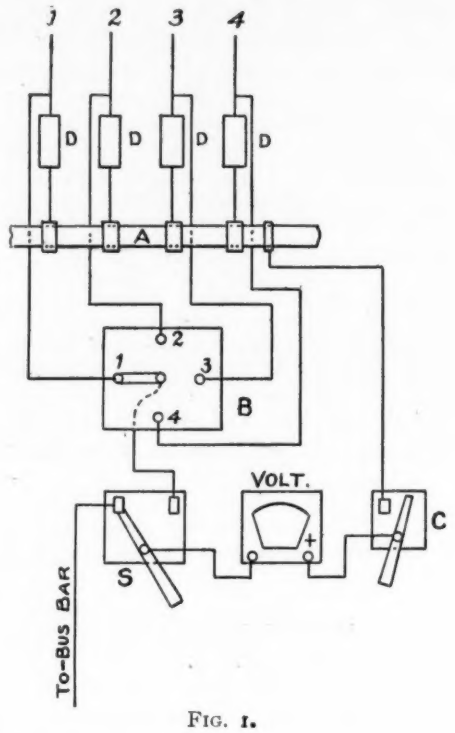


FIG. 1.

To test the insulation of a feeder and trolley section, let *A*, Fig. 1, represent a trolley feeder bus bar, with feeders Nos. 1, 2, 3 and 4 extending to different parts of the system. *B* is a voltmeter switch with wires from each of its contact points 1, 2, 3 and 4, connecting to the corresponding feeders on the line side of the feeder switches or circuit breakers *D*. Connect a wire from the bus bar to the positive binding post of a 600-volt-voltmeter, having a cut-out *C* in circuit and to the other side of the voltmeter connect a double-throw switch, *S*. Connect one contact of this switch to the lever of switch *B* and the other to the negative bus bar. To test, open all of the feeder switches, *D*, thus disconnecting the system of feeders and trolley from the power station. Now, throwing the switch lever of *S* so as to make connection with its left contact, and closing cut-out *C*, the reading on the voltmeter is the full-line voltage. Assume this to be 500 volts; then by placing the lever of switch *B* on No. 1 contact, and throwing the switch *S* to make contact at the right, it will give a series reading of feeder No. 1 and its connections, provided there is any leakage. Supposing a reading of 50 volts is obtained, and the resistance of the voltmeter equals 70,000 ohms, then using the formula $\left(\frac{v}{v'} - 1\right) R =$ Resistance of Insulation, where $V =$ the full line voltage $V' =$ the reading in series and $R =$ the resistance of the voltmeter, we have $\left(\frac{500}{50} - 1\right) \times 70{,}000 = 630{,}000$ ohms = the resistance of the insulation of No. 1 feeder and its connections (by feeder connections is meant the trolley wire it feeds). In the same manner the insulation resistance of the other feeders may be determined, and with a sufficient number of contacts on the voltmeter switch *B* any number of feeders may be so tested. The full-line voltage may be read in each feeder test to check any variation in voltage from the generator, but as this test must be made at night after the cars are all in the station, and when no load is upon the line, the voltage will not be liable to vary, or, at least, only so slightly as not to affect the result. Care must be taken that every lighting circuit be turned off from the feeder and its connections undergoing the test, for, with such a circuit on, the series reading *V'*

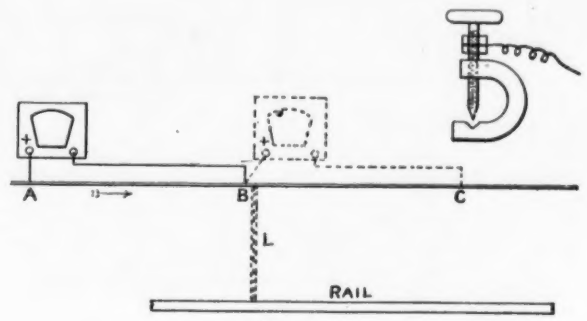


FIG. 2.

would be the full-line voltage or very near it. After the cars are housed at night, a few minutes will suffice for the switchboard tender to test all of the feeders and their connections in this manner.

If, on making the above test, it is found that on any feeder there is a serious leakage, and means are provided for separating it into sections, each section can be tested independently and the leaks located. If the feeder cannot be so divided, save by cutting, the following methods, employed after the cars are housed, may serve to locate the trouble: Disconnect the feeder having the faulty insulation from the bus bar and from the trolley it feeds, and send a current through it from an independent source (a dynamo in the station not in other use will answer), being particular to keep the current constant. Connect the positive binding post of a millivoltmeter to the station end of the feeder, as at *A*, Fig. 2, and at *B*,

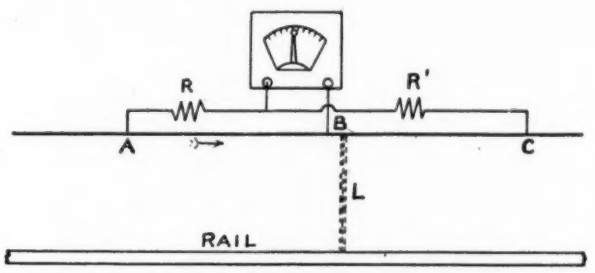


FIG. 3.

say 300 feet from *A*; tap the feeder again with a wire from the other binding post of the voltmeter and note the reading. Proceed in the same manner with the following 300 feet, and see if the second reading is the same as the first. This should be the case if the feeder is of even cross-section and there are no joints between the points of contact, which should be well made at each change. When, however, the point of leakage, *L*, is passed, the voltmeter needle will indicate zero, unless at some point *L'*, beyond *C*, another leak occurs, in which case a lower reading will be noted than that from *A* to *B*. A clamp similar to that shown in Fig. 2, which has been placed upon the market by a manufacturing company, is very useful in making connections with the feeder, as it will not injure the insulation, while allowing a good contact to be made. If it is not convenient to supply current to the feeder from an independent and constant source, a millivoltmeter, having the zero in the centre and reading both ways, may be employed, and the feeder supplied with current from the bus bar. This method is represented in Fig. 3.

Measure off equal lengths of the feeder, *A B* and *B C*, on either side of the connection *B*, and insert equal resistances of a few ohms each, at *R* and *R'*. If the current flowing in the section *A B*

is equal to that flowing in the section B C, the drop of potential from A to B will be the same as that from B to C, and the needle will stand at zero. If, however, there is a leakage at L, the current flowing from B to C will be less than that from A to B, and the needle will move toward the left. If the leakage were on the other side of B the needle would move in the opposite direction.

Whenever there is a leak from the trolley wires it must be due to the defective insulation of a trolley hanger, which allows the current to pass either to the span wire or to the cross arm if centre-

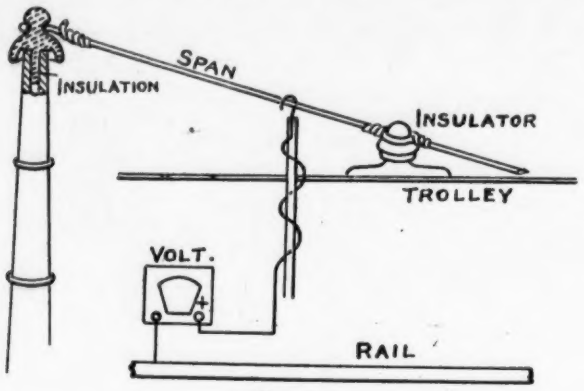


Fig. 4.

pole construction is used. It may be located by taking a pole having a hook on the end with a length of wire connected to it, and hanging it on the span wire, as shown in Fig. 4, the other end being connected to the positive binding post of a voltmeter, of which the negative binding post is connected to the rail. If the span wire is charged, it will be indicated by the voltmeter reading. If the cap of the pole to which the span wire is fastened is properly insulated, although the span wire is alive, there will be no leakage to the rail; but if its insulation is defective and the span wire is charged, there is at once a serious condition of affairs. To test the pole insulation, connect the positive binding post of the voltmeter to the trolley and the other binding post to the span wire. Mr. Frank Daniels has published in the *American Electrician* a modification of the above method. He attaches a spring to the trolley pole of a car, but insulated from it, a wire from which con-

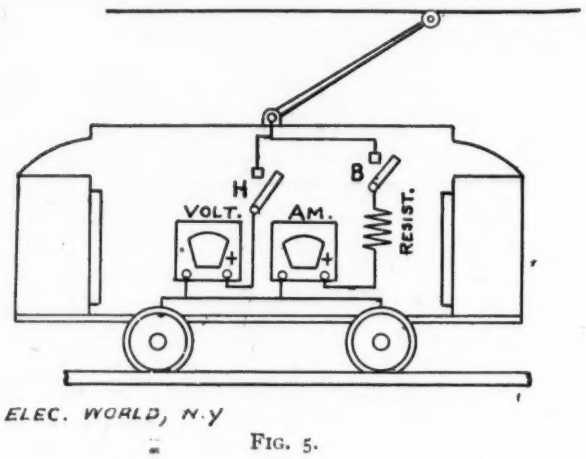


Fig. 5.

nects with the positive side of a voltmeter, the other side being connected to the motor ground. As the car runs under the span wire the spring makes contact with it, and if the span wire is charged it will be indicated by a voltmeter reading.

To test the resistance of the conducting circuit of the line, take to its terminus a resistance (motor starting resistance will answer, and there is generally a supply of them about the repair shop), an ammeter reading to 300 amperes, and a voltmeter reading to 600 volts. Make the connections as in Fig. 5, sending a heavy current through the ammeter. To test, first close the switch H, and take a reading of line voltage, calling it V; second, leaving the switch H closed, close the ammeter switch B, and read the amperes I and voltage V_1; third, open switch B, and read line voltage, calling it V_2. Then $\frac{\frac{V+V_2}{2} - V_1}{I}$ = resistance of line, *i. e.*, the combined resistance of feeders, trolley and rail return.

If $V = 500$ volts, $V_1 = 355$ volts, $V_2 = 510$ volts and $I = 250$ amperes, then the resistancce of the line would be

$$\left[\left\{(500 + 510) \div 2\right\} - 355\right] \div 250 = .6 \text{ ohms.}$$

$500 + 510 = 1010$, $1010 \div 2 = 505$ average voltage at no load, $505 - 355 = 150$ drop in voltage, $150 \div 250 = \frac{3}{5} = .6$ ohms resistance of line.

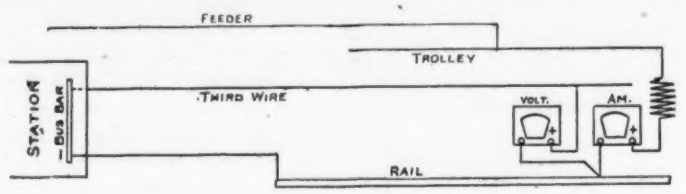


Fig. 6.

The accuracy of this test depends on the constancy of the voltage and the load, consequently it must be made at night after the cars are all housed, when the load will be only at the testing car, and may be easily kept constant. If the load is constant the voltage at the station should vary but little. The liability of variation in voltage at the generator occurs in throwing on and off the load at the car, but if the generator running at the station during the test is one of large capacity, a load of from 200 to 300 amperes ought not to cause much fluctuation. A method of checking the above test and thus increasing its accuracy is to have someone watch a voltmeter connected across the circuit in the station during the test, and note its reading when the current is on. Then subtracting the line voltage, with the current on, from the station voltage with current on, and dividing the remainder by the amperes on the line at the car, will give the line resistance. This may be expressed by the formula $\frac{E - E_1}{I} = R$, where E = station voltage; E_1 = line voltage; I = amperes at the car; R = ohms resistance of line (combined resistance of feeders, trolley and rail return).

If it is found that the line is of too high resistance, it becomes necessary to determine in which section of the line the fault lies,

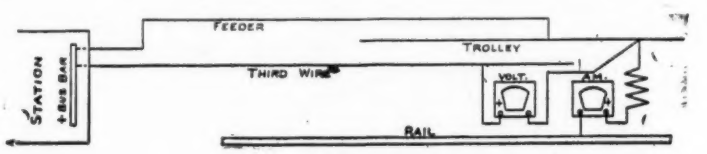


Fig. 7.

whether in the overhead construction or the rail return; consequently each must be tested separately. The most accurate method of doing this is by the use of a third wire.

To test the resistance of the rail return by this method, connect to the negative bus bar, Fig. 6, a wire running to the terminus of the line, join the other end to the rail through a voltmeter, and arrange to send a heavy current from the trolley to the rail by means of a proper resistance having an ammeter in circuit. Then the resistance of the rail return, from the point A to the station, equals $\frac{E}{C}$, the voltmeter reading divided by the ammeter reading. If $E = 100$ volts and $C = 300$ amperes, the resistance of the rail return $= \frac{1}{3} = .333$ ohms. This test should also be made at night, since all of the current flowing in the circuit should pass through the ammeter. To obtain the resistance of the feeder and the trolley, connect the third wire to the positive bus bar, and insert the voltmeter between the third wire and the trolley as in Fig. 7. Use the same formula as before, $\frac{E}{C} = R$. If, in the system, there are telephone wires running from the station to the ends of the different lines, by disconnecting these wires from their instruments they may be made to answer for a third wire. Where a line is divided into sections by circuit breakers in the trolley wire and supplied by separate feeders, one section may be used as a third wire and by conecting its feeder to the negative bus bar in the station the rail return may be tested.

To test the bonding of the rails a quick method in use is shown in Fig. 8. Taking a motor car, couple another to it by means of a long wooden draw bar. Connect the positive binding post of a low-reading voltmeter to the motor ground of the first car, and the negative binding post to the motor ground of the second car. Place an ammeter in circuit as shown and run with heavy current. When a rail joint of high resistance comes between the cars the voltmeter needle will indicate, and the larger the reading the higher the resistance of the joint. This test must also be made at night when no other cars are on the line. As dirt under the wheels of the first motor would cause a reading, it must be run with track

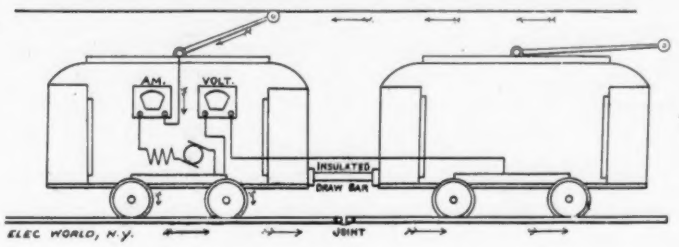


FIG. 8.

brushes down. Bad joints may be marked with a cold chisel, and afterwards repaired. On the return trip the instruments must be moved to the other motor car, which must push the first motor car ahead. The formula in this test is also $\frac{E}{C} = R$ if it is desired to find the exact resistance of a joint. The resistance of a joint can be compared with a section of the rail by means of a millivoltmeter, having zero in the centre and reading both ways, as in Fig. 3, having the joint come between connections B and C, and taking the length of rail from A to B. Then if the resistance of section $A\ B$ is equal to the resistance of section $B\ C$, there will be no deflection, the voltmeter needle remaining at zero. The advantage of this test lies in the fact of the travel on the line introducing no error; hence it can be carried on in the daytime. In conclusion, it must be emphasized that before making any tests of line construction the feeder map or blue print must be consulted, for without an exact knowledge of the location of section cut-outs, feeder taps, junction boxes, etc., you are working in the dark and may draw totally wrong inferences. All systems should be supplied with correct detail maps of their line construction.

Alternating Current Machinery.—XIII.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

CAPACITY IN ALTERNATING-CURRENT CIRCUITS.

113. While a condenser is a complete barrier to the passage of a continuous current, if we neglect the first charge or discharge and the residual effects of leakage and absorption, it gives passage to an alternating current. In fact, if we examine the current which flows in an alternating-current circuit, it is not, generally speaking, possible to determine, from the current alone, whether a condenser is or is not present in the circuit. Whereas, therefore, the impedance of a condenser is practically infinite to a continuous current, its impedance to an alternating current is a definite quantity which is usually by no means large.

114. The fundamental law which determines the current flowing into a condenser is that this current strength in amperes is the product of the capacity of the condenser in farads and the rate of change of the pressure at its terminals in volts per second; or $I = c\,\frac{de}{dt}$ amperes, where $\frac{de}{dt}$ represents the instantaneous rate of change of the pressure e. If e is a sinusoidal pressure, or $E \sin \omega t$,

$$I = c\,\frac{d\,(E \sin \omega\, t)}{d\,t}.$$

But the rate of change (¶ 42) of a sinusoidal E. M. F. of amplitude E and angular velocity ω is $E\,\omega \cos \omega\, t$, or $I = c\,\omega\,E \cos \omega\, t = c\,\omega\,E \sin\left(\omega\, t + \frac{\pi}{2}\right)$ amperes, so that the current in the condenser is a sinusoid of amplitude $c\,E\,\omega$ amperes, and advanced in phase $\frac{\pi}{2}$, or 90° ahead of the pressure. The amplitude of the current, therefore, increases in direct proportion to the capacity, to the pressure and to the angular velocity; so that if we increase the frequency of an alternating pressure without altering its effective value, we increase the current which this pressure will produce in a condenser. As an example, consider a sinusoidal alternator developing an effective E. M. F. of 1000 volts at its terminals at a frequency of 125 ∼. Suppose a condenser of one microfarad capacity connected directly across the alternator terminals. What will be the current which will flow through the condenser? Here $c = 1/1{,}000{,}000$ farad, $\omega = 2\,\pi \times 125 = 785.4$ radians per second (¶18), $E = 1000\ \sqrt{2} = 1414$ volts, so that

$$I = \frac{1}{1{,}000{,}000} \times 785.4 \times 1414 \sin\left(785.4\ t + \frac{\pi}{2}\right) \text{ amperes}$$

$$= 1.11 \sin\left(785.4\ t + \frac{\pi}{2}\right),$$

or the current is a sinusoid of 1⅛ amperes amplitude, and advanced 90° ahead of the pressure in phase.

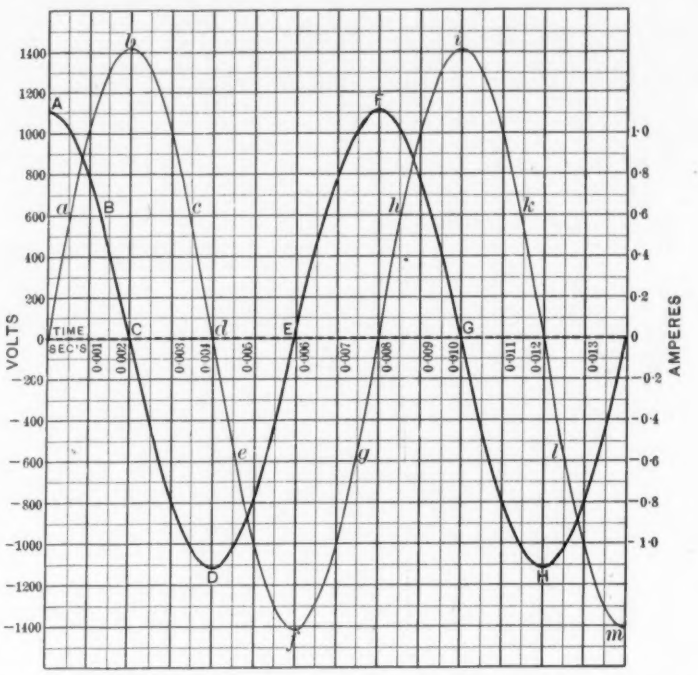


FIG. 72.—CURVES SHOWING CURRENT AND PRESSURE IN A CONDENSER.

115. This pressure and current are represented in Fig. 72, where the sinusoid curve, $O\ a\ b\ c\ d$, represents to the left hand scale a sinusoidal pressure of 1000 volts effective, with a period of 1-80 second, or a frequency of 80∼, and the sinusoid $A\ B\ C\ D$, represents, to the right-hand scale, the current strength passing into the microfarad condenser subjected to this pressure. The two curves are co-periodic, but $A\ B\ C$ is advanced 90° in phase beyond $o\ a\ b\ c$, being at a positive maximum when the latter is crossing the zero line positively. The time of starting, or $t = o$, has been chosen at some moment when the pressure starts in the positive direction from zero, and not at the moment of closing the circuit, since the current could not have the amplitude 1.11 amperes instantly on the closure. In other words, Fig. 72 represents the conditions after the steady state has been obtained, and not the initial state on closing the circuit. By comparing Fig. 72 with Fig. 54, we see that, whereas inductance in an alternating-current circuit retards the phase of the current, capacity, on the contrary, tends to advance it. The functions of inductance and capacity are, therefore, to some extent opposed to each other in the alternating-current circuit. It is to be observed, however, that whereas a lagging current is readily obtained of almost any desired strength with the aid of inductance, a powerful current with the aid of condensers requires either a high frequency, a large capacity, or a strong pressure. Thus, in Fig. 54, 8 amperes effective are seen to be flowing through a circuit of 60∼ frequency, under a pressure of 50 volts effective, whereas, with 1000 volts pressure only about 0.8 ampere effective is obtained in the case of Fig. 72, and to obtain 8 amperes at 50 volts pressure and 125∼ would require a condenser of about 200 microfarads capacity, or at 60 ∼ about 400 microfarads capacity. For

pressure alternating-current circuits. It possesses some importance in high-pressure alternating-current circuits.

116. We have already seen that $I = c\,\omega\,E \sin\left(\omega\,t + \frac{\pi}{2}\right)$ amperes. Consequently, if the pressure $E \sin\left(\omega\,t + \frac{\pi}{2}\right)$ be expressed as an effective value e, the effective current $i = c\,\omega\,e$ amperes; so that the impedance of the condenser is $\frac{1}{c\,\omega}$ ohms. This impedance is, however, not a resistance but a reactance, *i. e.*, a vector quantity to which the symbol j must be prefixed, since the effect of the condenser is to alter the phase of the current which flows. Moreover, the reactance of a condenser is oppositely or negatively directed to the reactance of an inductance under a given pressure, and therefore the impedance of a condenser, c, is $-j\,\frac{1}{c\,\omega}$ or what is the same thing, $\frac{1}{j\,c\,\omega}$ ohms, since $j = \sqrt{-1}$. A condenser reactance or negative reactance is commonly called a condensance to distinguish it from a positive reactance due to inductance.

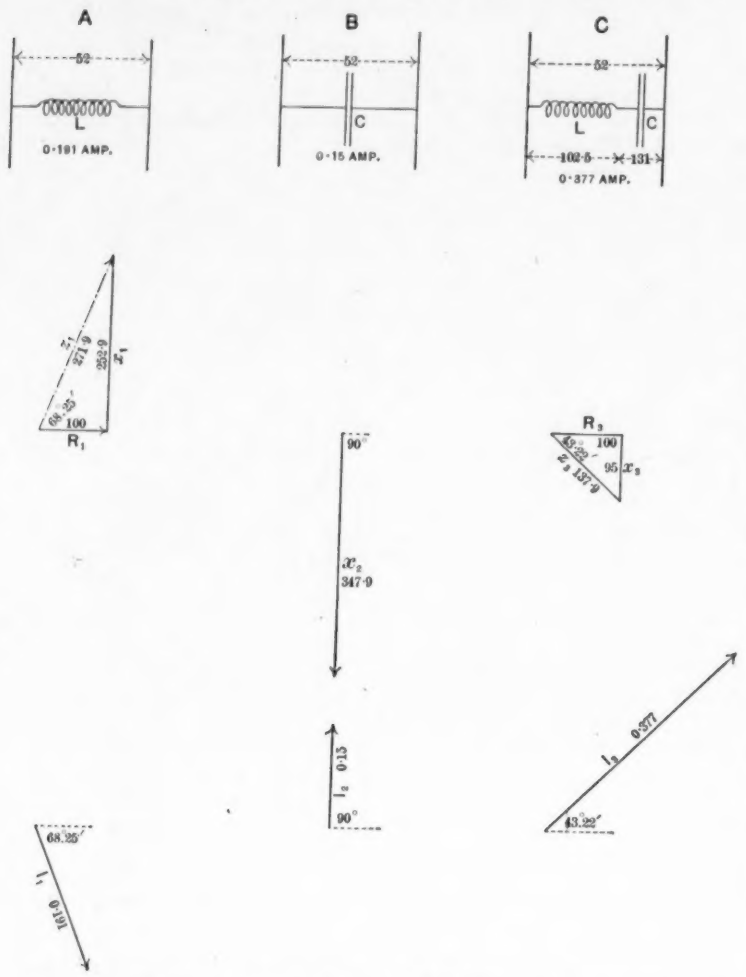


Fig. 73.—Diagram Illustrating Impedance of Condenser and Impedance in Series.

For example, the impedance of a condenser of one microfarad to a pressure of frequency 125 ~ and angular velocity 785.4 is $Z = -j\,\frac{1}{10^{-6} \times 785.4} = -j\,1273$ ohms $= 1273\,\underline{/90^\circ}$ ohms. Consequently the effective current which would pass through the condenser under an effective sinusoidal pressure of 1000 volts would be $I = \frac{1000}{1273\,\underline{/90^\circ}} = 0.7845\,\underline{/90^\circ}$ amperes, or an effective current of 0.7854 amperes, leading the pressure by 90°.

117. Owing to the fact that the reactance of a condenser is negative, the combination of a condenser and inductance coil in series has a reactance which is less than the arithmetical sum of their reactances. Thus, if a condenser offers to a sinusoidal current of given frequency a reactance of $-j$ ohms, and an inductance coil has a reactance of $j\,150$ ohms, the reactance of the combination formed by connecting the two in series will be $j\,(-100 + 150) = j\,50$ ohms. For this reason the impedance of a series-connected inductance and capacity is often much less than the impedance of either taken separately, as will be illustrated by the following examples based upon actual observations.

A condenser of 7.5 microfarads capacity (7.5×10^{-6} farad) is connected in series with a coil having an inductance of 0.66 henry and a resistance of 100 ohms. What will be the current supplied through the combination from a step-down transformer supplying an approximately sinusoidal pressure of 52 volts at a frequency of 61~.

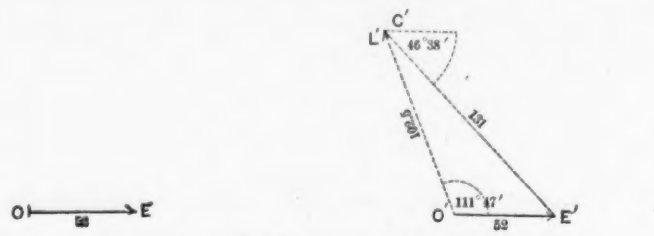


Fig. 74.—Diagram of Pressures in Condenser Circuit.

Here the angular velocity is $61 \times 2\,\pi = 383.2$ radians per second (¶ 44). The reactance of the coil will be $j\,0.66 \times 383.2 = j\,252.9$ ohms. The reactance of the condenser is $-j/c\,\omega = -j/(7.5 \times 10^{-6} \times 383.2) = -j\,347.9$ ohms. The total reactance of the combination will, therefore, be $j\,(252.9 - 347.9) = -j95$ ohms. The impedance of the combination is, therefore, $Z = 100 - j\,95$ ohms $= 137.9\,\underline{/43^\circ\,22'}$. The current flowing through the combination under a pressure of 52 volts effective will be $I = \frac{E}{Z} = 52/(137.9\,\underline{/43^\circ\,32'}) = 0.3771\,\underline{/43^\circ\,32}$ amperes. The impedance of the coil taken by itself is $100 + j\,252.9 = 271.9\,\underline{/68^\circ\,25'}$, while the impedance of the condenser alone s $347.9\,\underline{/90^\circ}$. Consequently, the current which would flow through the coil alone would be $52\,/(271.9\,\underline{/68^\circ.25'}) = 0.1912\,\underline{/68^\circ\,25'}$ ampere, and the current which would flow through the condenser alone in circuit would be $52\,/(347.9\,\underline{/90^\circ}) = 0.1495\,\underline{/90^\circ}$ ampere. It is, therefore, evident that the impedance of the combination is much less than either of the two component impedances, and that the current through the combination is considerably greater than the current which would flow through each component connected singly across the constant potential mains.

The above conditions are indicated in Fig. 73. At A, the coil L is connected directly across the 52-volt mains. The impedance of the coil is shown at Z_1 and the current at $I_1 = 0.191\,\underline{/68\ 25'}$, the current being drawn to a different scale. At B the condenser C is connected directly across the mains; the impedance of the condenser is $347.0\,\underline{/90^\circ}$ at X_2, and the current through the condenser is $I_2 = 0.15\,\underline{/90^\circ}$ ampere. At C the two are connected in series, giving a total impedance at Z_3, of $137.9\,\underline{/43^\circ\ 22'}$, and the current flowing through them is $0.377\,\underline{/43^\circ\ 22'}$ ampere.

118. In the last case the drop of pressure in the coil is $I_3\,Z_1 = 0.377\,\underline{/43\ 22'} \times 271.9\,\underline{/68\ 25'} = 102.5\,\underline{/111^\circ\ 47'}$ volts. The drop of pressure in the condenser is $I_3\,Z_2 = 0.377\,\underline{/43\ 22'} \times 347.9\,\underline{/90} = 131.1\,\underline{/46\ 38'}$ volts. It may at first sight seem unreasonable that a pressure of 52 volts between mains can support pressures of 102.5 volts on the coil and 131 volts on the condenser; or, a numerical total of 233.5 volts, but interpreted vectorially, the difficulty disappears, because $52\,\underline{/0^\circ} = 102.5\,\underline{/111^\circ\ 47'} + 131.1\,\underline{/46^\circ\ 38'}$ as shown in Fig. 74, where OE represents the pressure of 52 volts, $O'\,L'$ the pressure on the coil, and $C'\,E'$ the pressure on the condenser.

If, therefore, a condenser is connected to an alternating-current pressure in series with an inductance, it is possible that the pressure at the terminals of the condenser or of the inductance may be greatly in excess of the pressure acting on the combination.

119. When the reactance of the condenser is equal but of opposite sign to the reactance of the coil with which it is associated in series, the two behave in combination as though they had no reactance. Thus, if in Fig. 73, the reactance $X_2 = -j\,/c\omega$ be 252.9 ohms, then the reactance in the combination would be $j\,(252.9 - 252.9) = j\,0$. The combination would offer to the current only the ohmic resistance R, of the coil, and the current strength through the combination would be $I = E/R$, or would be the same as though the coil were connected to a continuous-current pressure of the same effective

value. Such a circuit is said to be a *resonant circuit.* Thus, if we connect an inductance coil and a condenser in series to a pair of constant-pressure sinusoidal-current mains, and gradually increase the capacity of the condenser from zero upward, we find that the current at first increases until a certain critical maximum value in reached, and then, as the condenser capacity is still further increased, the current diminishes. The maximum current is developed at the condition of resonance, *i. e.*, when the reactance in the circuit is zero; or, when the impedance of the circuit is equal to the ohmic resistance. Accompanying the maximum current there will be maximum pressure at the condenser terminals and also at the inductance terminals. For if X be the reactance of the condenser, and I the maximum effective current, then the pressure at the condenser terminals must be $E = IX$ volts, so that as I increases, so does E. The same is true of the pressure at the inductance terminals. The rise of pressure which occurs at the condenser or at the inductance over and above the value of impressed E. M. F., is called the *resonant rise of pressure*, or the rise of pressure due to resonance. Its value will depend upon the ohmic resistance of the coil. If the resistance of the coil be indefinitely small, the impedance at resonance will be indefinitely small and

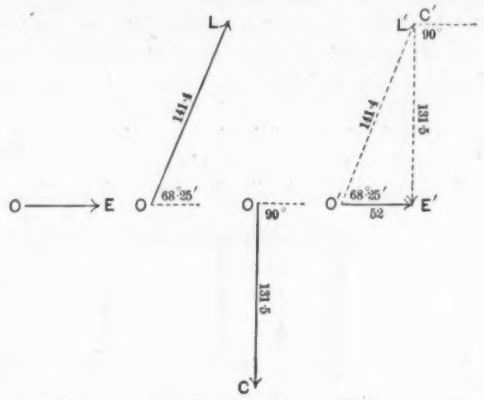


FIG. 75.—DIAGRAM OF PRESSURES IN RESONANT CIRCUIT.

the current indefinitely great, entailing thereby an indefinitely great resonant rise of pressure at condenser or inductance terminals. Practically, the resonance is limited not only by the resistance of the coil, but also by loss of energy occurring in the condenser or in the coil's core, if there be one, whereby the capacity behaves as though it possessed ohmic resistance, and the inductance behaves as though it had a greater resistance than its ohmic resistance. Consequently the resonant pressure at condenser terminals can seldom be made more than 100 times the pressure of the source. If the ohmic resistance of the resonant circuit is small, the rise of pressure and current is steep, and reaches a high maximum value as the capacity passes the critical or resonant value; while, on the contrary, if the resistance of the resonant circuit is great, the rise of pressure occurs slowly and gradually, as the condenser capacity passes the critical value, and the resonant rise of pressure is small.

As an example, consider the case represented in Fig. 73, when the capacity of the condenser C is made 10.32 microfarads, or 1.032×10^{-5} farad. In this case, the reactance of the condenser is $-j / c\ \omega = -j / (1.032 \times 10^{-5} \times 383.2) = -j\ 252.9$ ohms. The impedance of the coil previously considered, in circuit with the condenser is, therefore, $Z = 100 + j\ (252.9 - 252.9) = 100 + j\ 0 = 100\ \underline{/0^\circ}$ ohms. The current in the circuit is, therefore, $I = 52/100\ \underline{/0^\circ}$ ampere. The pressure at the condenser terminals will be $0.52\ \underline{/0^\circ} \times 252.9\ \overline{/90^\circ} = 131.5\ \overline{/90^\circ}$ volts, and the pressure at the coil terminals will be $0.52\ \underline{/0^\circ} \times 271.9\ \underline{/68^\circ\ 25'} = 141.4\ \underline{/68^\circ\ 25'}$ volts. This is illustrated in Fig. 75, where OE is the impressed pressure, OL the pressure on the inductance or the drop in the coil, OC the pressure on the condenser or the drop in the condenser, and $O'L' = C'E' + O'E'$. The pressure on the resonant condenser is 90° behind the impressed pressure in phase, while the pressure on the coil is somewhat less than 90° ahead of the impressed pressure.

120. The preceding method gives the simplest numerical treatment of a resonant circuit, since it considers the reactance of a condenser as similar in nature to the reactance of an inductance, but as having the negative sign. Such a consideration is, however, merely symbolical, and gives but an imperfect conception as to what is physically taking place in a resonant circuit. From a physical standpoint, the current in a resonant circuit is a maximum, because the frequency of the impressed E. M. F. is equal to the frequency with which the condenser would naturally discharge through the circuit if the resistance were negligibly small. The angular velocity with which a condenser of capacity c farads, will discharge through an inductance of l henrys, when the resistance is negligible is $\omega = 1/\sqrt{cl}$ radians per seconds; or, the frequency of discharge is $n = \frac{\omega}{2\pi} = 1/(2\pi\sqrt{cl})$ cycles per second. It is, therefore, easy to understand that when the impulses of impressed E. M. F. are co-periodic with the impulses which the condenser would develop in the circuit, the current which the impressed E. M. F. can develop is much more powerful than when its impulses are non-periodic with those of the condenser.

121. For every combination of a particular inductance in series with a particular capacity, there is always some one sinusoidal frequency of impressed E. M. F. which will develop resonance, *i. e.*, when $j\,l\,\omega - j / c\,\omega = 0$, or $l\,\omega = \frac{1}{c\,\omega}$, or $\omega = \frac{1}{\sqrt{cl}}$ radians per second. Similarly, for a given frequency and given inductance there is always one resonant capacity, *i. e.*, $c = \frac{1}{l\omega^2}$ farads, and again for a given capacity there is always one resonant inductance; namely, $l = \frac{1}{c\omega^2}$ henrys.

122. A variety of practical applications have already been made of the principle of resonance in alternating current circuits, although few are in extended commercial use.

The Pender Memorial.

A public meeting was held at University College, London, recently, to inaugurate a personal memorial to the late Sir John Pender. The Marquis of Tweeddale presided, and Lord Kelvin delivered an address.

The Marconi System.

It is stated that Signor Marconi made a large number of experiments last week at Rome on the new wireless-telegraphy system, at the request of the Italian Minister of Marine. It is rumored that the Italian Government has decided to apply the system to marine telegraphy.

Regulation of Alternating-Current Arc Lamps.

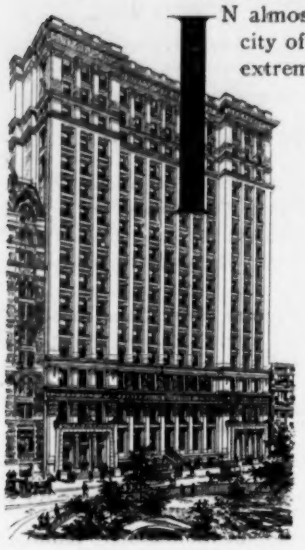
L'Industrie Electrique recently contained an article by Georges Claude, suggesting the addition of a condenser as a means of securing a better regulation in alternating-current arc lamps. Alternating arcs, he says, work poorly on account of the increased impedance resulting from the advance of the core. To remedy this he adds the condenser. The only practical objection to the use of condensers, he argues, is in connection with high-potential arc lamps. In the case of low-voltage arc lamps, however, the dielectric may be made very thin, and the condensers consequently need not be very large.

Another Fly-Wheel Accident.

Notwithstanding the fact that various appliances are available for preventing serious fly-wheel accidents, there are apparently but few cases where they are actually used. The necessity for protection of this kind was recently most prominently shown by an accident at the Tacoma Street Railroad Company's two-story brick power house, at Tacoma, Wash. A large 40-ton fly-wheel on one of the Corliss engines driving one of the railway generators, flew to pieces during the afternoon of July 11. Masses of iron and brick were thrown to a distance of about a block away, but luckily no one was killed, which, considering that the station had its full complement of attendants, is almost miraculous. Several of the attendants, however, were knocked down by flying bricks, and one had his leg badly crushed. It is said that the accident was caused by the breaking down of some of the governor mechanism, which caused the engine to run away. The engineer claims to have attempted to shut off steam, but found the throttle in such a condition as to make this impossible. The loss is estimated at about $20,000. Through this accident 30 miles of street railway were tied up for several days.

The Electrical Features of the Bowling Green Building.

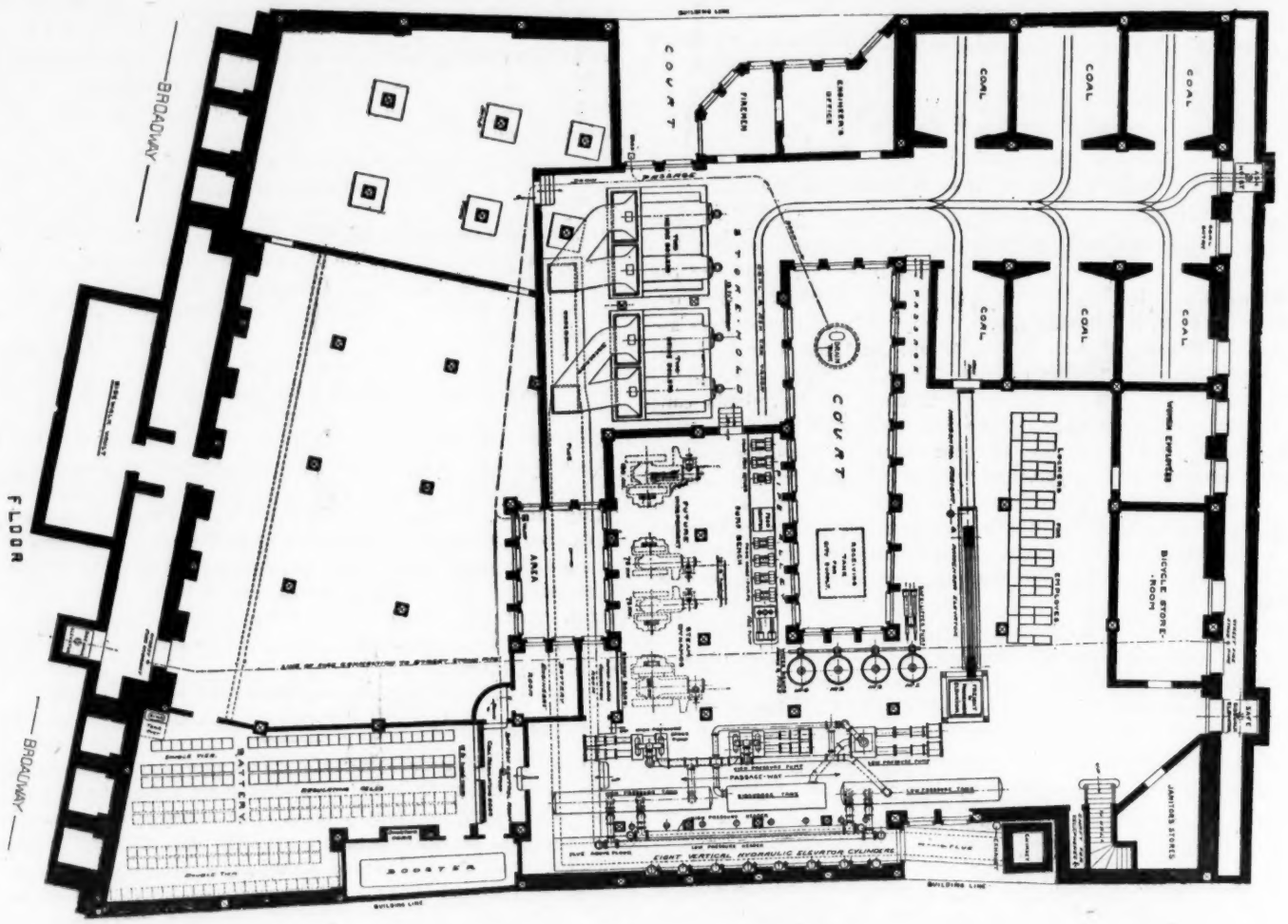
THE BUILDING AND ITS LOCATION.



IN almost the exact centre of the consolidated city of Greater New York, and at almost the extreme southern end of Manhattan Island, there has just been completed a building which for many reasons will undoubtedly long remain pre-eminent among the masterpieces of architecture devoted to business purposes. To the layman it will prove a worthy object of attention and interest, owing to its location, gigantic size, and its almost complete realization of the modern city within walls. For the engineer and all who are interested in the technicalities of such truly American productions it embodies many elements in its construction and equipment which are novel and worthy of close consideration and attention. It is the second structure on the west side of the southerly end of Broadway, facing Bowling Green, and deriving its name from the latter historic section of New York. As an example of magnificent and massive proportions this structure probably stands unsurpassed by any other of its kind in the city. It has a frontage on Broadway of 200 feet and occupies a plot extending 196 feet back to Greenwich Street, making a total ground area of almost 40,000 square feet. Guided, however, by the desire to make every office open to air and light, the building has been built around an immense court and practically forms an E, extending upward for sixteen floors above ground level to a height of 235 feet, and extending downward an additional 50 feet, where, in the cellar, the machinery of this immense institution is located. Although exceeded in height by but a few of our metropolitan skyscrapers, its loftiness is entirely in keeping with the base area of the building, which, partly owing thereto and to the excellent design, gives an impression of a structure of well-proportioned size, rather than tower-like ugliness. The building is constructed entirely of milled steel framing on a pile and grillage foundation. The front wall is of granite, terra cotta and white brick, the latter forming the sides and rear as well. Over one-half of the building has been given up to court, halls, etc. So lavishly has this arrangement been carried out that practically only a little over 15,000 square feet remains on each floor for rental. The conveniences provided are in many instances novel and unique, including bathrooms and ice water supply; but of particular interest are the various novel departures made in the electrical and mechanical equipment of the building. The many distinctive features of this plant, mechanical and electrical, are due to Mr. Reginald P. Bolton, who had the entire engineering work in charge. Messrs. W. & G. Audsley were the architects for the building, which is owned by the Broadway Realty Company, whose president is Mr. Spencer Trask, the well-known banker and president of the Edison Illuminating Company.

ELECTRIC LIGHT WIRING AND FITTING.

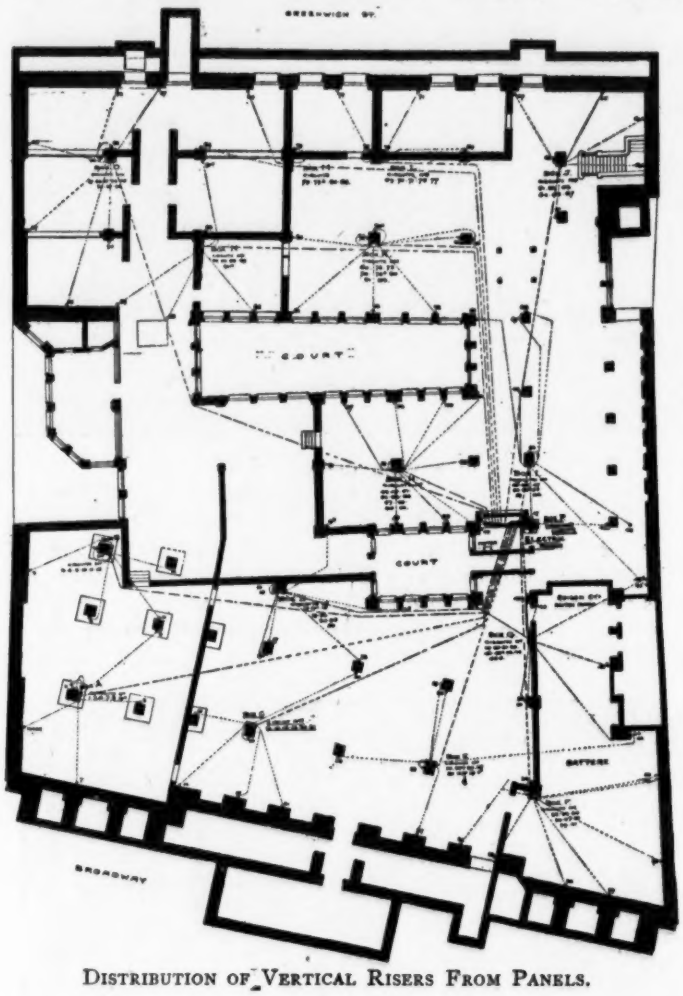
Located throughout the building are about 6000 16-cp incandescent lamps carried on all-electric fixtures which are insulated by insulating joints from the outlet box nipples to which they are secured. The fixture wires are connected through porcelain-covered fuse bugs. These lights are connected from 3300 outlets. The wiring and current supply embodies two departures—the use of plain steel conduit pipes and lead-armored twin conductors, and a vertical distribution system which almost entirely eliminates lateral runs and concentrates all distribution and panel boxes in the basement of the building. The conduit equipment of the building will certainly be carefully watched by all who are interested in the respective merits of lined and unlined conduit tubes. This extensive installation includes some 77,000 feet of plain steel pipe, ranging in sizes from ¾ to 1½ inches interior diameter, coated inside and outside with an asphaltic paint. This pipe was supplied by the Crane Company. The conduit tubes terminate in round outlet and square junction boxes, each tube end being accurately fitted into a coupling bug on the exterior of the box and made flush



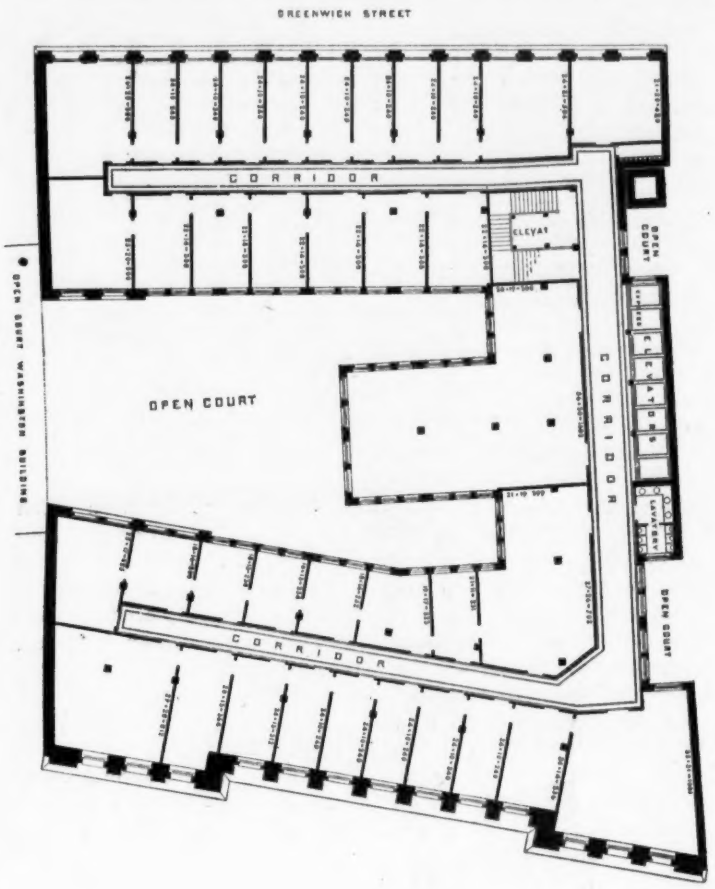
Plan of Machinery Department, Sub-cellar.

inside and waterproofed. All bends and elbows were made on the premises, in some cases around columns as small as 1 inch in radius. Owing to the vertical distributing system all this conduit pipe, excepting the runs in the basement, is placed vertically and was cut in lengths at the factory. It was very readily placed, as few changes were required after the first disposition.

It was originally intended to use a heavily braided duplex rubber-covered wire through these tubes, but the Inspection Bureau of the New York Fire Department prohibited this plan. Rubber insulated conductors protected by a thin lead armor manufactured by the Safety Insulated Wire & Cable Company were therefore



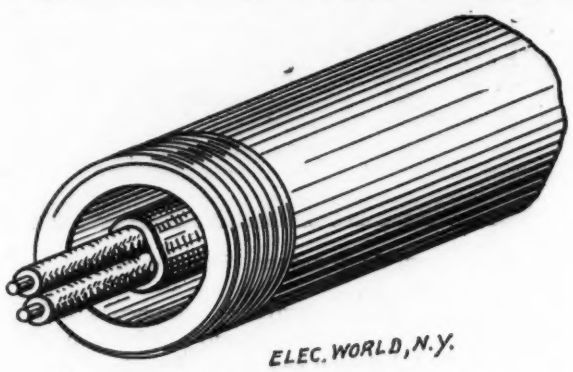
DISTRIBUTION OF VERTICAL RISERS FROM PANELS.



TYPICAL FLOOR PLAN.

adopted in order to comply with these inspection regulations. All smaller circuit wires on vertical runs are duplex parallel lead-sheathed conductors, ranging from 16 B & S to 8 B & S, while the mains in the basement from the switchboard to the panel boxes are single double concentric lead-sheathed conductors ranging from 0 B & S to 365,000 c. m. About 250,000 feet of lead-covered conductors were used.

The ample room afforded by the absence of insulating material

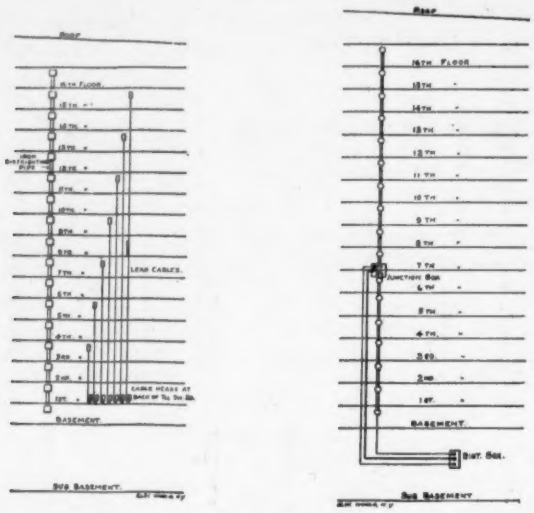


TWO-WIRE CABLE IN TUBING, ACTUAL SIZE

in the tube between the wire and the tube space is greatly conducive to the ease with which the conductors can be drawn in and withdrawn. Pieces of cable of 250,000 circular mils cross-section were pulled in some cases through 180 feet of pipe, including three bends, and showed no material abrasion. To facilitate the wire pulling all conductors were thoroughly greased with ordinary axle grease, and when so prepared were very easily handled. The writer witnessed some of this work and afterward examined the conductor and was agreeably surprised by the results in both instances. The experience gained led the engineer and the Globe Electric Construction Company, who installed the entire electric wiring system to believe that, as far as the mechanical effects resulting from pulling the wire through the conduit are concerned, a well-protected braided conductor, if similarly handled, would serve equally well. The system as installed, however, is considered by them as being somewhat more substantial and secure. Incidentally the present installation represents an economy in first cost, but that it would afford a superior system was the pre-eminent consideration.

When the wiring system for this building was first laid out the Bolton vertical system was considered, and has been adopted in this as in other large buildings. This wiring plan offers peculiar advantages, particularly in office-building work, where the lights on one floor are practically reproducible on the next, thus forming sets or groups of lights in almost straight vertical lines. Each of these vertical groups is supplied by a separate vertical riser or line. In this installation the three-wire system of wiring has been used. From the main switchboard a number of three-wire mains ramify horizontally over the cellar ceiling to various centres, where panel distributing boxes are located. To the bus bars of these each respective set of mains is connected. The arrangement and disposition of these boxes is shown on the plan. Fifteen are used for general office lighting, and one for halls and all public lights. They are placed on the side walls or pillars, and are easily accessible. Each box is slate-lined, with glass doors, and is equipped with a directory, giving the direction, etc., of the various vertical riser circuits tapping off the panel bus through triple pole knife switches and fuses, and extending to various vertical risers in the vicinity of each panel. The mains to the panels are run so that two wires arranged concentrically and lead-sheathed, of the three-wire circuit are in one pipe and the third in another. From the panel connections each vertical riser extends to a central balancing point, which is on the eighth floor, or one floor above or below. Here a junction box is located, to which the neutral wire of the riser is

connected, and from which it extends up and down, feeding the lights in that particular group. The general arrangement is shown in the diagram. Owing to the adoption of the three-wire system, the neutral and one outside wire are brought up through one pipe. The neutral divides at the junction box, going up through one pipe with one outside wire brought up to the box with the neutral, and extending down with a wire forming the other side of the three-wire circuit, and connected at the lower end of the panel. Lights



Vertical Wiring and Telephone Distribution System.

are directly tapped off on both runs. Small slate boards, on which suitable contact blocks are mounted, are used to divide the neutral through fuses at the junction boxes. The neutral wire has twice the cross section of the outside wires on all circuits. For corridor lighting distributing junction boxes are placed on each floor, similar in general arrangement to those previously described, excepting that several circuits ramify through switches from the box to the hall lights on each floor.

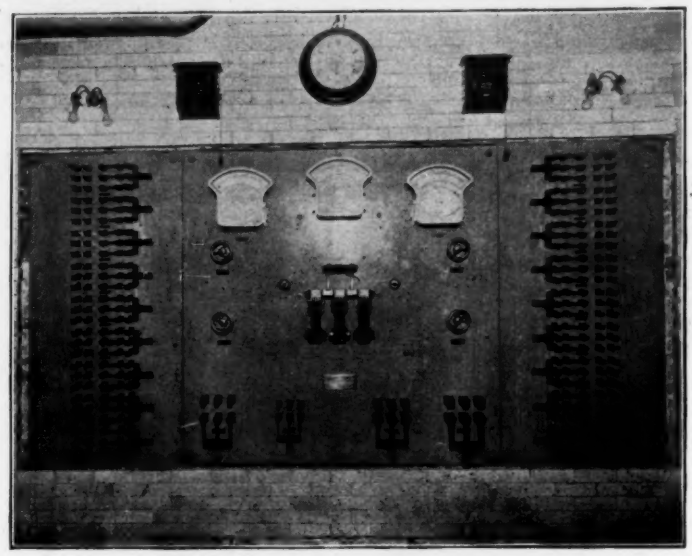
By this arrangement the failure of any particular vertical circuit due to any cause only involves the extinction of that row of lights, and as each office is supplied with lights on several risers no inconvenience is caused and the darkening of one entire floor is impossible. A floor failure can only be caused by an absolute and total failure of current supply. When a fuse blow occurs the placing of all panels in the basement affords a rapid and easy means for quick renewal. Although fuses are placed on the neutral at the junction boxes on the upper floor also, the lower fuses are more likely to blow, and even should the upper fuse go it can readily be gotten at, as all junction boxes are located in readily accessible places, and have simple screw-fastened iron covers. Aside from the above features and the ease of pulling in the conductors in the conduit, it is claimed that a saving in copper and labor of over 25 per cent. over the ordinary arrangement results.

Isolated Generating Plant and Main Switchboard.

At the present time the building is not supplied from an isolated generating plant, but current is taken from the Edison Illuminating Company's system. This current is transmitted from the Duane Street station to a storage battery sub-station, occupying a large portion of the basement of this building. Arrangements have, however, been made for the installation of an isolated generating plant, which is to be installed in about a year's time. Foundations have been set complete for four units, to consist of General Electric dynamos direct connected to Harrisburg Foundry Company's Ideal Engines. These units will consist of one 100-kw, two 75-kw and one 50-kw outfits. Edison service from the sub-station is to supplement the isolated supply when installed.

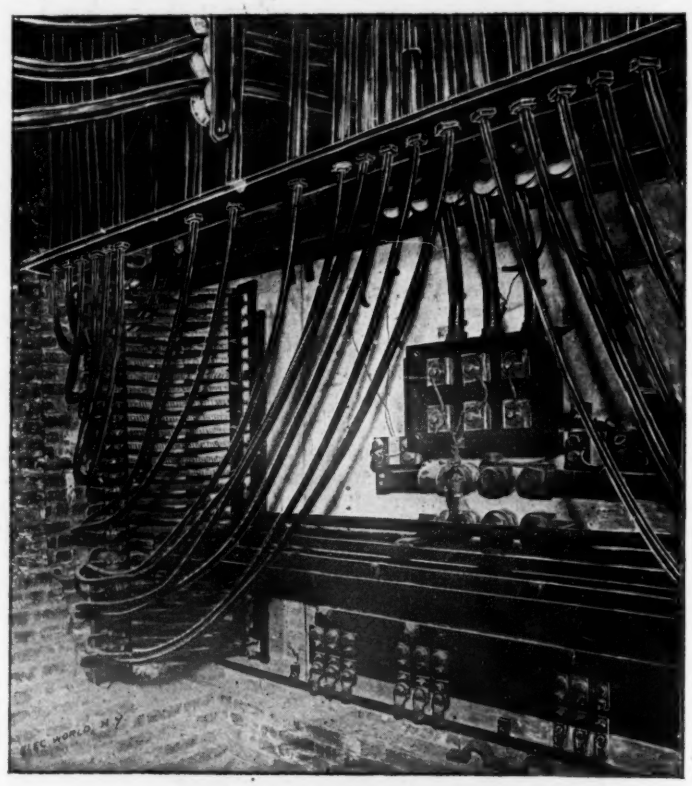
In accordance with this arrangement the switchboard has been laid out to provide for both supplies. It embodies some new features devised by Mr. Bolton, and was constructed by the Ideal Electric Corporation. The board consists of three panels of Tennessee marble, mounted on an iron frame surrounded by a bronze moulding, and the whole set in a wall of cream enameled face brick forming one side of a room behind the board. This has a window opening into the open court at one end, a door at the opposite end, and a wall about 8 feet back from the rear of the board. This unique electric switchboard room is lighted by daylight.

The two side panels of the board are entirely devoted to feeder switches, which are three-pole, double-throw knife switches arranged horizontally one above the other. The central panel is for dynamo-control apparatus, and contains four three-pole main dynamo switches and one large 3000-ampere three-pole knife switch. These control the Edison service, which is connected thereby to a set of horizontal station supply bus bars, which extend to each of



The Main Switchboard.

the feeder panels. At these they connect at each end to a set of vertical feeder supply bus bars, from which each of the vertical row of feeder switches is tapped on one side. This arrangement leaves the back of the board entirely clear of connections crossing the bus bars. At present two ammeters are mounted on the central panel, one on each side of the three-wire system, and a voltmeter



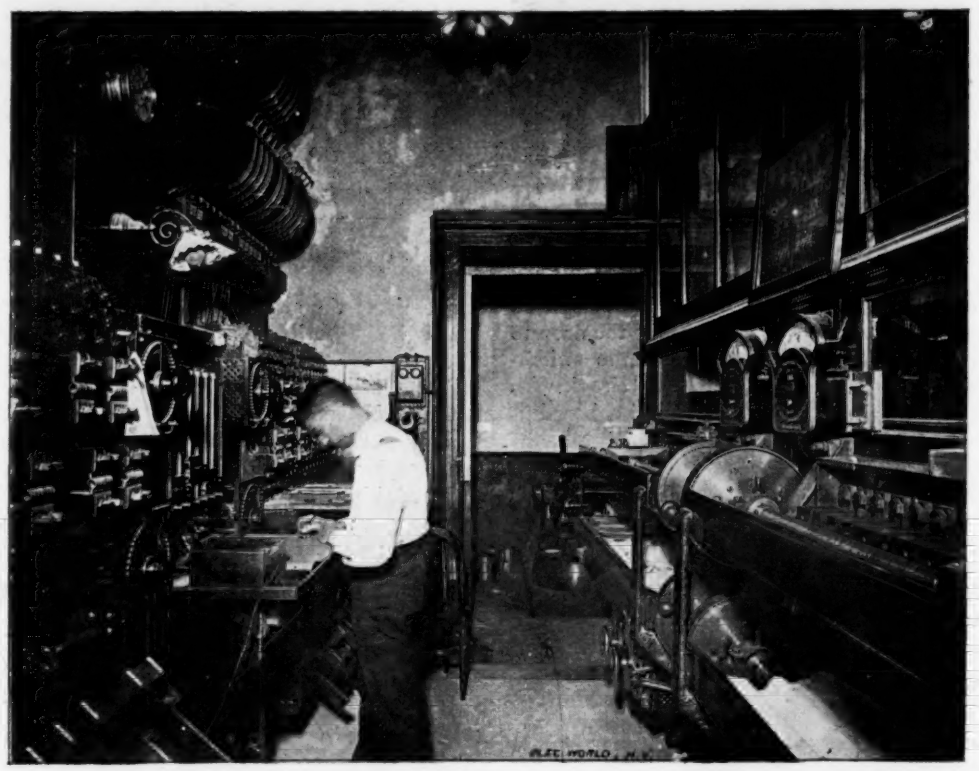
Behind the Switchboard, Showing Risers.

and ground detector are also provided. Ammeters will later be provided for each dynamo. The dynamo bus bars correspond to those above described, being in fact duplicate and connected to the other side of the feeder switches. On the back wall of the room the main-service cut-out and meters are mounted. Overhead cables on heavy porcelain insulators are brought to this point from the sub-station switchboard, and from thence to the main switch. The various feeder pipes and circuits are brought to a pipe-holding strip at the back of the upper end of the board, and are rigidly and

symmetrically held, the wires being looped sideways from the centre to the switches on each feeder panel, to which they are connected by copper strips. There are eighteen feeder switches. Surmounting the board on the brick wall is a clock, having on each side an annunciator which connects with the fire-alarm signal boxes. No fuses are placed on the face of the board. In the back two vertical fuse panels are arranged, one at each feeder panel, and the feeder cables are connected to these fuses and from thence to the central switch blades.

THE EDISON STORAGE-BATTERY SUB-STATION.

Under the main hall, in the cellar, where a head room of 21 feet was obtainable, a space measuring about 60 x 25 feet has been properly walled and partitioned off from the remainder of the cellar and is occupied by a storage-battery sub-station plant of the Edison Electric Illuminating Company, of New York. It includes a storage-battery plant of 150 cells, manufactured by the Electric Storage Battery Company; switch-controlling room, and booster equipment. The battery room extends practically the whole length and width of the above-mentioned space, an L being taken off at one end to provide for a booster and switchboard compartment. In order to make the battery-room floor thoroughly waterproof, which was essential, owing to it being below the water line, a foundation of concrete was laid, followed by several layers of asphalt and felt and then more concrete. Between these layers a series of vitrified hollow tiles were placed and the feeder cables entering from the street at the battery end of the plant are brought through these ducts to a cable vault under the switchboard room at the other end. This feeder duct is inclined toward the vault. On top of this composite flooring a finish of white vitrified tiles is laid. The walls are water and acid proof, and are covered with slate. Every precaution has been taken to protect the steel pillars in the battery room, which have been covered with asphalt, a layer of lead, cemented again, asphalted and then bricked in. Various drains from the battery room lead to cesspools.



SWITCHBOARD AND CONTROL ROOM, ACCUMULATOR SUB-STATION.

Being used for three-wire distribution, the battery plant is arranged in two sections, each of seventy-five cells. The battery has a capacity per side of 2000 amperes for one hour, 1000 for three hours, and 400 for ten hours, at which latter rate the battery charges normally. Each cell is made up of fourteen "Manchester" positive and fifteen "Chloride" negative plates, placed in lead-lined wooden cells, measuring about 40 inches high by 21 by 30 inches, and set on porcelain insulators in rows on wooden benches. In each set of seventy-five batteries there are included twenty regulating cells, which are separately connected to the regulating switches in the switchboard and controller room. Two regulating switches are provided for each set of regulating cells, so that the battery on each side of the three-wire system can be worked at two potentials. The connections between batteries and to the switching apparatus are all bare copper bars and the joint connections are very ample. These bare copper bars are supported on porcelain insulators fixed on iron beams. The great height of the battery room will permit of future additions in the form of a gallery over the present installation.

In the booster compartment forming one end of the L is located a motor booster outfit, consisting of two motors and two dynamo boosters, all direct-connected on a common shaft. The motors are in the centre, one on each side of the three-wire system, and can be used singly or together, and the dynamos are at each end and are used to raise the E. M. F. in charging and sometimes in discharging. Each dynamo has a capacity of raising the E. M. F. at 1200 amperes by 60 volts, and the motors are of 75-kw capacity.

In the controlling and switchboard room are located the various switching, regulating, measuring and controlling devices for the storage batteries, and also the distributing and feeder circuits from and to the sub-station. On one wall nearest the battery room are located the four storage battery regulating switches, which consist of long-sliding nut contact bars, operated by a screw, which is turned by hand, the contact block making connection with contacts from each of the various regulating cells and the common battery bus. A dial adjacent to the operating handle indicates when each particular regulating cell is connected into service. The opposite wall of the controlling and switchboard room contains the feeder switches, bus bars and indicating instruments. All these are arranged on the Van Vleck edgewise system, resulting in a marked saving of space. There are three buses on this board, any one of which can be used to supply the various apparatus, as required. The shunts of the edgewise Weston ammeters are connected on all circuits excepting the feeder circuits. For the latter the ammeter is shunted across a portion of the cable. Apparatus is also provided for battery and feeder potential measuring.

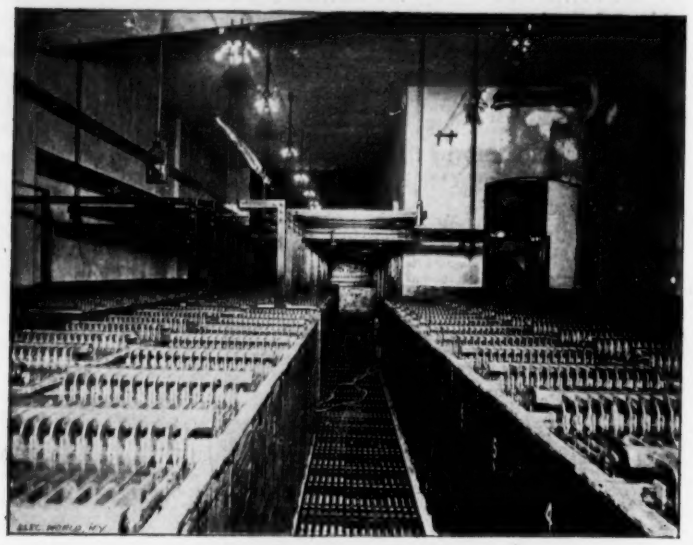
It may be here mentioned that this station was installed to be used in place of the previous sub-station located at the Produce Exchange, which is almost immediately across the Green. The extensive plant necessary for the Bowling Green Building and the large amount of current to be consumed were probably the most prominent factors in deciding the present location. From the Edison station at Duane Street, almost a mile distant, four feeders extend, each equipped with controllable switch boxes of the Bowker-Van Vleck type. These feeders connect with the general distributing system, but can be automatically disconnected therefrom by the switching devices in the previously mentioned boxes. When used for distributing purposes the current can be supplied from both the Bowling Green sub-station and the Duane Street station; while disconnected current from the Duane Street station can be directly supplied to the Battery station. It is claimed that the new storage battery sub-station actually permits of shutting down the Duane Street station during the hours of light load and the running of the entire system of the lower district by the Twelfth Street and Bowling Green storage battery stations. By all means the largest service connection from the sub-station is directly in the building.

THE ISOLATED CENTRAL OFFICE TELEPHONE SYSTEM.

In each office throughout the entire building there is located a telephone set, consisting of transmitter, buzzer, receiver and push-button, each set being connected by means of a single two-wire circuit with the central-office switchboard located in the main cor-

ridor on the ground floor. There are about 300 instruments in the building, all of which have separate circuits to the switchboard, and are provided there with drops and suitable jack-plug connections.

The transmitters are of the Ericsson coal-grain type, and are operated without induction coils, being directly connected to the board. The receiver of each instrument is of the watch-case type, with a resistance of about 70 ohms. No local batteries are used whatever, one central battery at the switchboard furnishing the necessary current for calling, and a separate battery for talking



The Accumulator Sub-station.

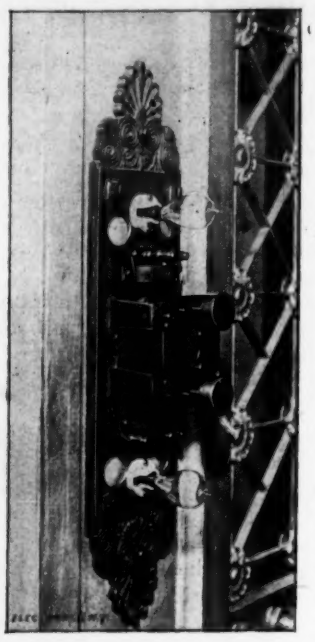
for all the instruments. In calling, the operation of the button on the wall instruments completes the circuit, which causes the drop to fall, thereby closing a ringing attachment circuit at the switchboard. The talking battery is bridged over the ringing circuit with the operator's instruments, when necessary. The switchboard is of very elegant design, having a framework of quartered oak, the drops being covered by glass. All drops are mounted on the upper section, while the jack contacts are on the lower. A large number of flexible cord-connecting wires and plugs are provided,

Interior Telephone Switchboard.

as well as a centrally hung operator's transmitter and a head-receiving attachment. The drops can easily be reset by means of two handles, one at each end of the board, which need only be given a quarter turn to cause the drops to return to their normal position.

The wiring system is unique. All the wires from the various connections on the switchboard are brought to a set of seven cable heads back of the board, forming the end terminals of seven paper-insulated lead-covered cables which ramify to the various floors of the building, extending upwards through the wire shaft. These cables end at alternate floors, where they terminate in other cable heads, each separate wire terminal being in turn connected to a terminal on a telephone panel board. Running vertically through the building and adjacent to these panel boards is an iron pipe, having an easily accessible outlet box at every floor. From the previously mentioned panel boards, forming the terminals of the

An Interior Telephone Set.



An Elevator Call-Box.

cables from the switchboard, the wires are run into this iron pipe through the outlet box and pass to the floor above or below and thence to the various offices. The economy in time and reduction of the elevator loads is expected to more than pay for this additional convenience to tenants and visitors. Uuquestionably the operation and economical value of interior central station telephone systems for office buildings will be watched with great interest.

In addition to the central station system a separate private telephone system is also installed, connecting the various offices of the general manager and other officials with the janitor, engineer's room, etc. The telephone system was installed complete by the Wilson-Bates Electric Company, Habirshaw wires being used from the panel boxes, while the cable was furnished by the National Underground Cable Company.

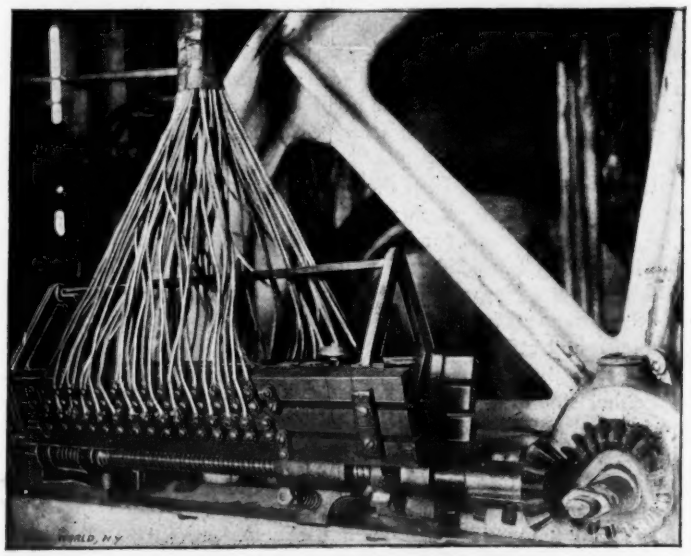
SIGNAL SERVICE.

A complete wiring system has been installed throughout the building for various signal service, such as public telephone, messenger calls, burglar alarms, etc. This service consists of two sets of lead-armored cables with outlet connection boxes at each floor, from which points the wires may be run to the different offices. In the cellar a very elaborate set of vaults is provided for the use of the tenants, and these are protected through the burglar-alarm service wires. A complete watchmen's time-detector system, and also a system of electric time clocks, has been placed about the building, the master devices being located in the general manager's room, and secondary clocks and watchmen's stations being located on the different floors. A fire-alarm system is also installed, consisting of a glass-front contact device, connecting with the previously mentioned annunciators and gongs in the basement.

ELEVATOR-CALLING SIGNALS.

A very complete electric signal system for calling the elevator cars from any landing also forms part of the electrical equipment. This system embodies many exceedingly ingenious features and was installed by Benner & Opdyke. Before describing this elevator-calling system it may be stated that there are eight passenger elevators arranged in a row on the north side of the building. Some of these are for express service, while others stop at every floor. At each landing there is located a double push-button contact device, shown uncovered in the illustration. One button of this device is marked "up" and the other "down." The mechanism is inclosed by a metal front and upper and lower end covers, while the sides are protected by glass, having marked at each end the words "to go up" and "to go down" in transparent letters. Behind these, on the base of the contact device, are placed small incandescent lamps

which are kept lighted, clearly indicating the text on the glass. Each contact, either up or down, consists of a push rod, which, when depressed, brings into contact several connection strips, and either one of these pushes, when operated, is held in a locked position by a small electromagnet. From each contact device, only one of which is located on each floor, a series of six wires extends to a switchboard on the top of the elevator shaft. One common switchboard is used for the terminals from all the contact devices on the different floors. The board is of marble, with brass contact terminals. From these contact terminals the wires of each respective contact device extend to what is known as the commutator, a device which is mechanically connected to the cable sheave of each respective car. The commutator consists of a central screw shaft rotated by bevel gears connected to the previously mentioned cable sheave. On this screw shaft moves longitudinally a nut which has attached thereto two contact strips. At each side, at a slight angle to the central shaft, are a number of insulated contact buttons, all of those on one side being from the up-contact pushes of all the call boxes, while those on the other side are for the down pushes. When the sheave is revolved in one direction the threaded shaft of the commutator takes a corresponding direction, and the traveling nut, by friction, is thrown over against one series of contact points. When the direction is reversed, the direction of travel is reversed, and the nut is thrown against the opposite contact points. In this way, when going up, the car signals can only be actuated by up pushes, while in going down the signal can only be actuated by down pushes. From the commutator to its corresponding elevator car is run a three-wire cable, part of which is flexible to accommodate itself to the ascent and descent of the car. Two of these wires connect with the buzzer in the car which serves as a signal, while the other is normally closed through a push button, and is used for preventing the push from being unlocked by opening the releasing magnet circuit of the push button in case the operator should find that his car is too heavily loaded to take on any additional load. The operation of the button in the car holds the call button in contact for the next car. From one contact of each call box a wire is run to an annunciator on the ground floor, which serves to indicate when a call is made to the starter. This annunciator consists of a number of magnet coils, which, when a button is pushed, are energized, holding up the needle of that particular call and only releasing it when the push button itself is released, thus opening the circuit, including the magnet in the call box and the annunciator. The connection of the signal in the car with both of these devices and the battery actuates the push release magnet, which serves as a return signal. This annunciator has no



COMMUTATOR FOR ELEVATOR CALL SYSTEM.

particular value during the busy hours, but serves the purpose of a call at night or at other times when the cars do not make regular trips. The operation of the system is exceedingly simple. Should either an up or down button be pushed that particular button will serve to connect the signal in the nearest approaching car of the entire group, as soon as it reaches a point within seven-eighths of a floor space from the floor on which the actuated call device is located. The entire system works automatically and the signal is only heard in that one car or cars which come within this distance of the floor at which it is desired to stop, and has, therefore, some advantages over signals in which the buzzer or bell is rung in all cars. The general operation and connections of this system will readily be understood from the diagram herewith.

ELECTRIC ELEVATOR TRAVEL INDICATORS.

To operate in conjunction with the previously mentioned calling system there has been installed an electric-elevator indicating sys-

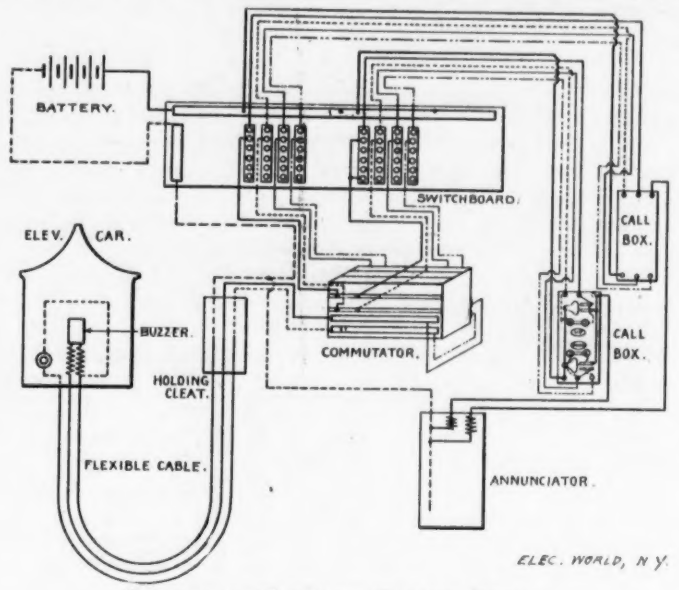


DIAGRAM OF ELEVATOR CALLING SIGNAL.

tem, so that anyone desiring to go up or down only needs to push the button for the desired direction, and then watch the indicator to see which shaft his car will arrive at. This apparatus was installed by the Elevator Supply & Repair Company. Each of the eight passenger-elevator shafts is provided with a separate indicator showing the car movement, but these indicators are placed in a somewhat novel and ingenious fashion. There being sixteen floors in the building, an indicator to indicate each particular floor advance of the car movement would be a device of large proportions, entirely too cumbersome for practical purposes. It was, therefore, decided to adopt an arrangement whereby the indicator starts to show the movement of the car only three floors in advance of its arrival at the floor on which the indicator is located on the up trip, and on the down trip indicates the movement of the car only until it reaches the floor on which the indicator is located, after passing which it no longer shows the movement of the car on that particular indicator. This scheme meets the requirements completely, and has enabled the use of a very compact mechanism.

The device itself is of an exceedingly novel form. In general operation it is similar to the ordinary mechanical indicating arrangements, consisting of a wire extending the length of the shaft and operated by suitable wheels connected to the cable sheaves. This wire connects at the different floors with a mechanically operated contrivance indicating on a dial the movement of the car. In order, however, to adopt the method above mentioned, electricity was used for indicating purposes. As far as the mechanically actuated device is concerned, the arrangement is as already described. Instead, however, of simply having a pointer or disc to be moved up or down by the wire, a small incandescent lamp is attached to the moving wire, and is given the necessary upward and downward movement. This lamp, which is enclosed in a small box so that its light is concentrated, is placed in an ornamental casing in front of each elevator shaft, and has in front triangularly placed glass sides, each of which has transparent lettering, through which the light of the incandescent lamp is clearly seen. The indicating signal is given by the illumination of this lamp behind the figure designating the floor. The movement up and down illuminates each successive letter. In order to provide for the above a very ingenious switching mechanism has been adopted, whereby the lamp is illuminated only three floors in advance on the up trip, and extinguished after the car has left the floor on the down trip. For this purpose the lamp carrier, which slides on suitable rods, is provided with two switch arms, one of which slides continuously on one contact strip, while the other makes and breaks contact with a central contact strip on the up

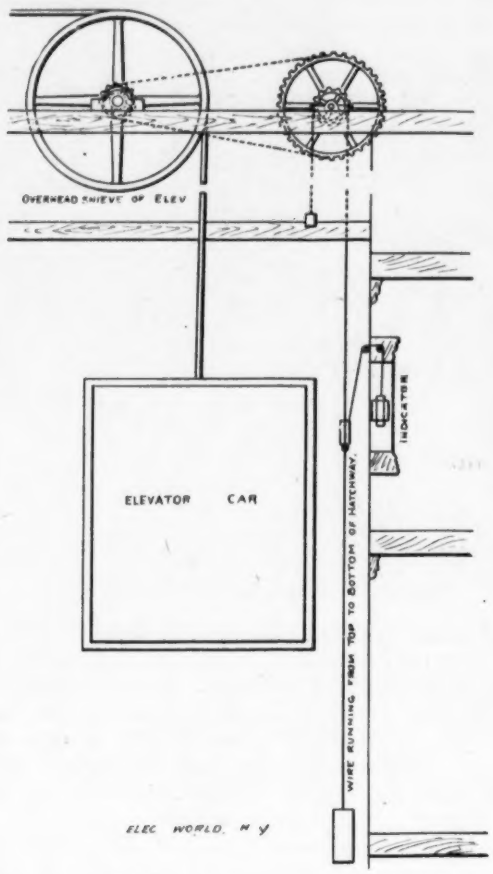
movement, being switched on to a third outside contact strip on the down movement, the latter strip terminating after the car has left the floor. These strips are mounted on the back board of the indicator.

THE STEAM PLANT, ELEVATOR SERVICE AND WATER SUPPLY SYSTEM.

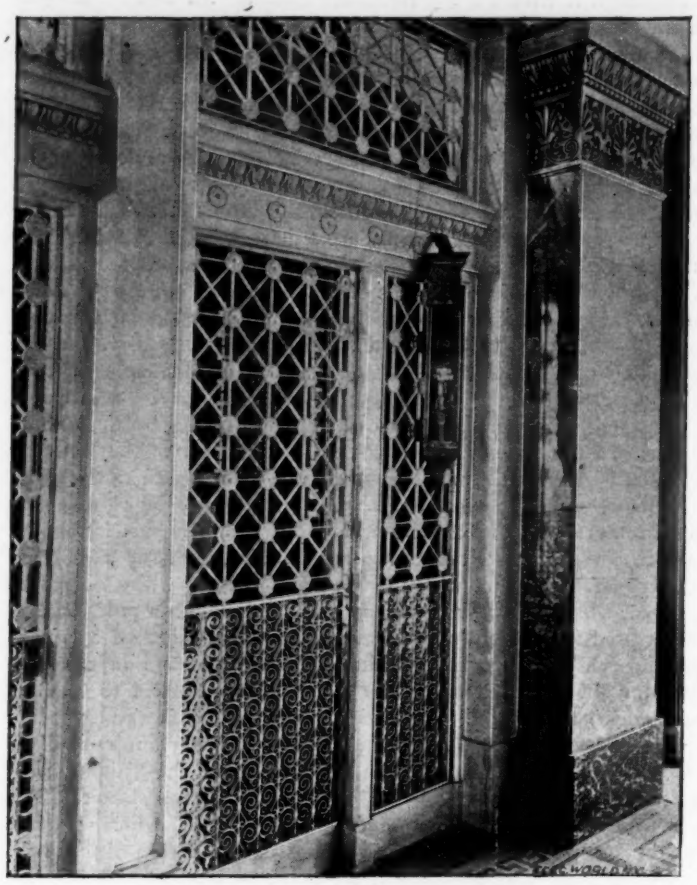
For the operation of the heating, pump and large hydraulic elevator plant, consisting of eight passenger elevators, one heavy freight machine and one hydraulic sidewalk elevator used for the storage-battery plant, two batteries of Heine boilers are provided, having a gross rating of 750 horse-power. Each battery consists of two boilers. These boilers work at a pressure of 110 pounds, and the grates are of the McClure rocking pattern, being designed for the use of buckwheat coal. The chimney is an immense structure for an office building. It is of sheet steel, 5½ feet in diameter, and extending 15 feet above the building. Coal is brought to the boilers in a small car on a narrow-gauge track from the storage bins on the southwestern or Greenwich Street side of the cellar. These bins have a capacity for 300 tons. Provision has been made for an automatic coal-conveying system, which will afford a larger storage capacity.

The service for the passenger and freight elevators is of the double-pressure type, furnished by the Otis Company. A double set of triple-expansion pumps is used, pumping into two tanks, one high and the other low pressure, from which the water supply for the elevator cylinders is taken through suitable valves operated by lever devices from the car. It is to be noted that for all the water and pumping supply system, no roof tanks whatever are used, the pressure tanks of every description being located in the basement. In addition to the elevator pumping system a very complete hot and cold water supply system is provided, which employs an ingenious arrangement of pressure tanks designed by Mr. Bolton. It may also be stated that ice water is supplied from marble basins on each floor, and a complete refrigerating plant is located in the basement for this purpose.

The heating system of the building is supplied either by exhaust or live steam, circulation being secured by the Webster vacuum system. The pumping service for boiler feed is also very complete, and a very elaborate system of fire pumps and stand pipes has been provided. There are about 23,500 feet of steam and return pipes used throughout. Altogether the entire plant has been designed with a particular view toward economy and permanence.



Method of Operating Elevator Indicators.



One of the Elevator Indicators.

Niagara Power.

BY F. M. F. CAZIN.

Two immediate causes have produced the following lines, namely, my late investigation of the Niagara power question as a matter of business, and the publication of L. B. Stillwell's paper, which I highly appreciate as introductory to what I desire to say in regard to such features of the Niagara power question as were left entirely out of consideration by him. The quoted paper gives figures for the maximum power theoretically obtainable as 5,800,000 horse-power, and reasons are stated for the probable practical limitation to 3,200,000 horse-power, or 55 per cent., in which limitation aesthetic consideration stands for a considerable fraction. The paper further justifies the role actually assumed by electrical power transmission in connection with power utilization at Niagara and elsewhere.

It is the main purpose of the present paper to discuss the features of power absorption from the falling waters as actually practiced, and to indicate a line for improved methods and machinery.

The aesthetic consideration, the romance of the falls, has its value, but it is improbable that it will continue to materially impede power utilization at Niagara when the conflict between romance and utility arrives.

A strikingly curious contrast exists between the two governments on either side of the cataract; on the one hand one of them, spending some millions of dollars toward surrounding the falls with public parks, for the purpose of giving to common folks an opportunity to inhale the sentimental mists, to feast their eyes on ceaseless motion, and their acoustic nerves on the thunder of the falling liquid hammering the solid rocks underneath; and the other one creating a gigantic monopoly for the utilization of the power inherent to the gravitating waters.

The mechanical power, some 4,000,000 horse-power, which in consequence of such creation may be wielded by the one strong hand, the concession on either side being virtually the same, will easily win the day when the conflict between romance and utility arrives. It, nevertheless, is not idle speculation to ask a question:

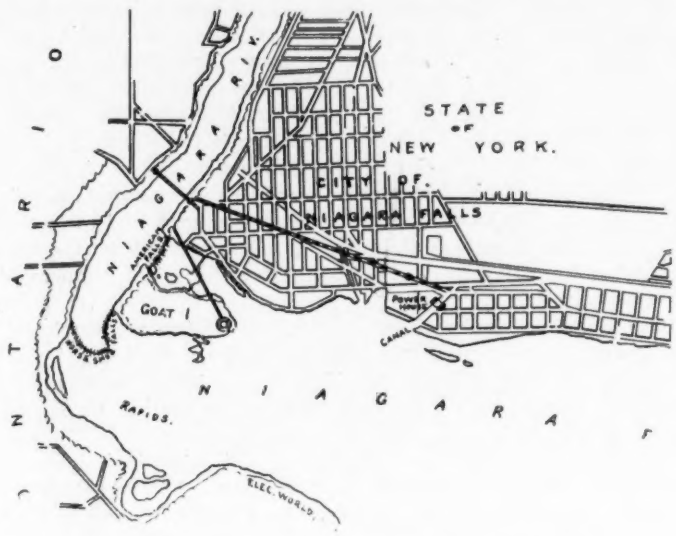
Should there be a final limit, set by the adjacent governments, which shall not be overstepped, and beyond which the character and beauty of the falls must be preserved as one of the wonders of the world, as an object of national pride, and possibly in respect

for traditional if not vested rights of adjacent estates in such preservation?

If the time does not appear as at hand for setting such a limit, it is pardonable to consider it as approaching when the financiering powers of the nation seriously contemplate doing away with the steam locomotive engine, and substituting in its place power transmitted by wire and originated where, as at the falls, nature itself has made provision therefor.

Before attempting an answer to this question of limitation, it appears opportune to speak of those organizations to whom the decree of limitation will have to be eventually directed. Individual enterprise lacks all reasonable ground of complaint against the action of the two governments in creating a corporate monopoly, because neither in the past periods of prosperity nor in the periods when depression in trade called for more economical power production has individual enterprise made any serious attempt toward taking advantage of the bountiful gift which nature itself has presented to human industry in the falling waters at Niagara.

If there is a cause of complaint it might be in the hands of the people at large, on the ground that the compensation paid by the monopoly ($25,000 per annum on the Canada side) is inadequate



MAP SHOWING PRESENT AND PROPOSED TUNNELS.

and not proportional to the benefits enjoyed. Even such a complaint has no equity as its support, because it is the very consequence of a fixed revenue for the preliminary period (twenty years on the Canadian side) which must drive and hasten the monopoly to make power utilization works on a grand scale, the benefit of which, in its final results, must accrue to industry and transportation at large.

The time when socialistic governments on this continent will undertake to build power stations, to operate them, and to apply the power to railroads and factories, is apparently remote—so remote that nature will have converted the horse-shoe fall into a straight or lane fall before it will arrive.

It is better to allow concessions to a monopoly than to defer doing a good thing until the improbable comes to pass.

On the other hand, the falls themselves plead the case in favor of reduction to one-tenth or one-fifth, by demonstrating undiminished beauty where a thickness of a few feet only falls over the same as in places where a thickness of 18 to 20 feet tumbles into a hidden cavity. As the matter stands, there is no ground now and there is no prospective ground on which paternal government might reasonably curtail power utilization at Niagara.

But strange to say, the Niagara Falls Power Company has introduced a fundamental curtailment, not of water-quantity diverted from the falls, but of the power that may be produced by the quantity of water diverted from the falls, and the same power company has committed other fundamental errors which call for a warning against their repetition. This applies to all present plans with only one laudable exception, namely, that of the Niagara Falls Hydraulic Power & Manufacturing Company, which, though participating in the consequences of one unfavorable feature in the method of water abstraction, has in its plant avoided all so far avoidable errors. This unfavorable feature, common to all, I intend to discuss.

The power that is inherent to water falling between two points, one of which is on a higher level than the other, remains the same whether these two points are laterally distant from one another for one mile or a hundred miles.

To render this power industrially available the falling water that is to be made productive of useful power must be confined, while falling, for the purpose of confining the expression of power to one point and to control it at such point.

As a consequence, the economical value of falling water is measured by the lateral proximity of the two points of greatest difference in level. When the lateral distance between the points of different levels is great, the contrivances required (head-pipe, ditch, etc.) may neutralize the entire economical value of the falling water.

Only where rapid descent of water, whether sudden or successive on sloping ground, permits comparatively short piping, the falling water constitutes a value, and the shorter the lateral distance between highest and lowest level the higher is the economical value of the fall.

On the very face of the conditions prevailing at Niagara the falls constitute an enormous value, by reason of the short lateral distance between the highest and lowest level, but the appearances are deceptive to a degree, because the falls proper are only a part of a total fall, the rapids above the falls consuming a considerable fraction of the total available difference in level.

The last mentioned fact, supported by aesthetic considerations, has originated one of two fundamental errors in execution, namely, the lengthening out of the head-ditch and head-pipe arrangements beyond adequate limits, an error the future avoidance of which in new means of power production will save to the power companies, when they will have reached the limit of their present head-water arrangement, a material portion of the cost per horse-power.

The second fundamental error, avoided in the plant of the Niagara Falls Hydraulic Power & Manufacturing Company's newer plant but introduced and maintained in the plant of the Niagara Falls Power Company, consists in utilizing the power of the diverted water in part only, letting go to waste a further fall of water that might produce an increased power (nearly double) as over its present production.

The cause for thus curtailing the utilization and for discarding as waste what might produce additional power may be found in part in a generally prevailing favoritism toward the use of turbines, and in part in the imperfect method of setting up for operation these preferred and favored turbines.

It having been decided to adhere to the obsolete system of vertical spindles, a limit was set to the portion of head that could be utilized, notwithstanding all precautions resorted to for distributing the strain of the cumbersome structure.

Such partial utilization of fall leaves room for a supplementary adaptation of the present plant to a more rational use of the falling distance. But even such supplementary adaptation cannot bring the upright spindle system to uncomplicated efficient simplicity, as it is represented in the newer plant connected with the older ditch, of which plant Mr. W. C. Johnson is the designer and executor. This plant is set up as near to the lowest level of the falling water as practical, and has no need for upright spindles. The turbine makers, to adapt their wheels to the rational conditions of this newer plant, had to go out of their common way, and build their turbines on a horizontal shaft, a construction essentially foreign to the turbine and resulting in a cumbersome and much complicated housing.

An impulse wheel, by the very nature of things, would have met the requirements more adequately had there been, at the time of construction, an impulse wheel in the market that left a possibility of deriving benefit of the portion of the head situated below its own level.

The proper selection at the present date will in consequence rationally lead to the abandonment at Niagara of the turbine altogether, and to the setting up of impulse wheels, in which the loss of the lower part of head is counterbalanced by the sucking action produced by a Toricelli waste pipe, discharging in submersion, and which are, on the face of fundamental conditions, more efficient under the high available head.

Not only will this be productive of a less complicated construction and of a higher efficiency, but it will also introduce more facile methods of governing, and result in a plant uncomplicated, reliable, and efficient to a degree, such as would be absolutely unattainable with turbines.

Whatever improvements in the details of the power plants may be introduced, none of them are equal in importance to the correction of the great fundamental error committed for various causes in the arrangements made for covering the lateral distances between the two spots where the waters leave the Niagara River, and where they return thereto.

For shortening the lateral travel of the waters, when present ditch and tunnel capacities will be exceeded, the following suggestions are made:

At the upper end of Goat Island nature has given (see the adjoined map) all the necessary conditions for sinking an annular caisson of sufficient dimensions to leave an inner space for sinking a shaft of sufficient depth for reaching the high-water mark below the falls, and of sufficient capacity for multiplying present power production.

If statutory limitation has prevented such action, it is pertinent to say that statutes are not immutable, and aesthetic considerations might well be satisfied by an artistic exterior of the structure, which, when carried out in full, would reach an elevation that will be on a level with the smooth waters of the upper Niagara, and be connected with them by two jetties.

On the level of the tunnel, or of a plurality of tunnels driven in at the level of high-water mark on the lower Niagara from the bluff immediately below the falls, to meet the shaft, a road of travel for the water may be prepared, shorter than which none can be made—a road that will not occupy a square foot of surface. On close examination the fact is revealed that some of the dolomitic strata to be cut by such shaft and tunnels are of such a soft character that space may be cut out therein at about the same cost that it could be covered in by a log cabin. Such a stratum may be followed for the major part of the tunnel length and need only be left near its two ends.

There will be no need of loss of head in the tunnel itself, because the water when entering the lateral stretch has its full falling velocity, which in the spindle wheel case is taken out of the foot of the shaft, leaving the waters the necessity of taking a new start with no initial velocity.

That the European wheel builders did not select turbines built on the Jouval principle of a divided head is a neglect for which no sufficient cause appears.

There will be no necessity for metal head pipes in shaft or tunnels. Part of the material cut out, when laid in cement, will serve to secure the walls and proper gates at the inlet will give all facility required for repairs.

Only at their outlets the tunnels must be hermetically joined to metal headers or water reservoirs, which will rest on the embankment, and to which all connections will be made for the ejection of water into wheels that will answer to simple governor contrivances, adapt themselves in dimensions to speed requirements, and avoid all the many complications with which the older plant is harassed.

The company that utilizes the older canal has approached perfection and will reach it in its extensions by discarding the turbine for the better adapted impulse-wheel, thereby winning back to American manufacture and ingenuity the ground lost by over-zealous subservience to European experience.

A Very Compact Electrical Plant.

It often happens, in buildings devoted to special purposes, that very little space can be given up to the electrical and power equipment, and the ingenuity of the engineer is often taxed to the utmost in distributing the apparatus in such a manner as to obtain the maximum of economy and convenience. Such was the case in the New York Clearing House, situated at 78-83 Cedar Street, New York, where it was found absolutely necessary to utilize the greater part of the basement for the huge steel vaults in which are stored the millions of dollars of bullion used in the bank-clearing system. The building itself is a magnificent structure, beautifully finished inside in marble, and for the amount of floor space is the costliest in the country.

In the engine room are two Ball & Wood engines, one 12 x 12 inch, the other 10 x 12 inch, the former direct connected to a 40-kw Western Electric dynamo, the other to a 30-kw dynamo of the same type.

The large machine is wound for 120 volts, and furnishes current for the lighting system, while the smaller one, which runs at 220 volts, supplies the electric elevators with power. At the end of the room is a marble switchboard, a cut of which is shown, containing two Weston illuminated dial voltmeters, besides two ammeters of the same type, in addition to the usual complement of feeder and main knife switches. These are arranged to be thrown on the Edison street service after 6 P. M., or in case of a breakdown of either machine. For additional convenience a marble gauge board is provided, which can be seen from any part of the room, and which carries a boiler-pressure gauge, or back-pressure gauge, besides a recording steam gauge and a Howard marine clock. As shown in the illustration, the engine room is very much cramped, but nevertheless the engines run with such remarkable smoothness and steadiness that there is no objectionable jarring or noise, and no expenditures for repairs of any kind have been made since their installation nearly two years ago.

The same lack of space is found in the boiler room, which is partially separated from the engine room by an iron partition, and many expedients have been adopted to accommodate all the necessary machinery. Steam is supplied from a battery of two Babcock-Wilcox water-tube boilers of 100-hp capacity, while a vertical water tube boiler is provided to be used in case of emergency, or when either of the other boilers is being inspected. Just beyond the boilers is a large blow-off tank, into which steam and refuse from the boilers may be blown and then emptied into the sewer by a Worthington pump. There being no room for a coal bin on the floor, an iron coal bunker is suspended from the ceiling, and communicates with the sidewalk by a manhole. A spout delivers the coal to a barrow only a few feet from the boiler doors, and the handling of the coal is done in a most economical and cleanly manner. The feed water, after passing through a Berryman heater, is delivered to the boilers by two Worthington pumps, and the water which is supplied to the building is fed to a large tank on the roof by another Worthington pump of larger capacity, which is operated automatically by a pilot valve.

Both the direct and indirect systems of heating are employed, the former by exhaust steam from the boilers, the latter by air supplied by a pair of Sturtevant blowers run by an auxiliary engine, and heated during the cold weather by passing through a series of steam coils.

The elevator service consists of three Otis electric freight elevators and an Otis passenger elevator, operated by the Leonard system. One freight elevator is used for transferring bullion from the sidewalk to the Clearing House vaults; another delivers bullion from the sidewalk to the vaults of the Chase Bank, also located in the basement; while a third connects the vaults with the bank offices.

The floors of both the engine and boiler rooms are laid in white tiles, which, besides presenting a beautiful appearance, assist materially in obtaining greatest cleanliness and neatness.

The building is wired throughout on the three-wire system, and each of the five floors is equipped with a slate-lined junction box having the terminals completely fused and fitted with small knife switches for controlling the main circuits. The system is arranged at the switchboard to be run on the two-wire plan when fed from the dynamo, but in case of emergency or after 6 P. M. at night the Edison street service may be thrown on, restoring it to its original form.

Over 1200 incandescent lamps are installed throughout the building, although the maximum load rarely exceeds 500. Some beautiful lighting effects are obtained, especially in the dome of the exchange room and in the directors' room. In the former a circle of 190 lights is arranged, divided into sections and operated by magnetic cut-outs. The latter room is lighted by a skylight of yellow stained glass within which are sixty-eight incandescent lamps. The effect is similar to that of sunshine. There are in addition the same number of lights arranged in groups of five depending from brass fixtures and likewise controlled by magnetic cut-outs.

Rules for High Tension Installations in Germany.

At a recent meeting of the Verband Deutscher Electrotechniker held at Eisenach, the Committee on Rules and Regulations relating to high-pressure electricity works reported that they had only put forward the conclusions which they had come to tentatively, and recommended a postponement of the final rules for another two years. The proposition was agreed to. The next place of meeting of this society will be at Frankfort.

DIGEST OF CURRENT TECHNICAL ELECTRICAL ARTICLES

COMPILED FROM FOREIGN AND AMERICAN JOURNALS

BY

CARL HERING

DYNAMOS, MOTORS AND TRANSFORMERS.

Armature Reaction with Three-Phase Generators. BRAUN. *Elek. Zeit.*, June 24.—A reprint of a long paper read before the German Society of Electrical Engineers, in which he discusses, with the aid of a large number of diagrams, the magnetic relations, with a view to determining from these how three-phase generators should be constructed so as to make the armature reaction as small as possible; this reaction is manifested by self and mutual induction; the object of the paper is not to show how the loss of voltage may be determined, but to explain the magnetic relations. His conclusions are briefly as follows: The saturation should be as high as possible; the path of the exciting lines of force should have as low a magnetic resistance as possible, and the reacting lines as great a resistance as possible, which latter is accomplished by a proper disposition of the magnetic parts; the grooves in which the coils lie should therefore be as open as possible at the ends; better results would be obtained when these grooves are so large that they pass through the whole armature; the exciting portion should also be grooved as deeply as possible and the iron should be well saturated. In the discussion Goerges explained at considerable length the difference between armature reaction and self and mutual induction, the two latter of which are often treated together. Dobrowolsky discussed the subject from the standpoint of a practical constructor who required simpler methods, even though they were not as accurate; referring to the recent long discussion in that journal he remarked that there was a lack of practical deductions of a quantitative nature; he mentioned a number ot practical points which have apparently not been considered at all in the paper; among other things he states that the distance between the pole tips should be somewhat larger than the width of the pole pieces, a rule which is not followed as often as it should be; another point which was not considered is the deformation of the field; he questions whether the practical constructor has any use for a high degree of accuracy in the predetermination of the loss of voltage, and he believes that methods already exist which are satisfactory approximations for practice; machines cannot be constructed without due allowance for a factor of uncertainty which can be compensated; regarding the determination of the loss of voltage he claims that the best method is to divide the current into two components, of which the wattless portion gives those ampere windings which should be subtracted or added to the field winding, which latter are easily calculated; the Kapp diagram is easily applied in a few minutes and gives results which are sufficiently accurate for practical purposes.

Hysteresis Loss in Toothed Armatures. BRESLAUER. *Proc. Lond. Phys. Soc.*, June.—An abstract giving the concluding formulas of the article noticed in the *Digest*, March 6 and April 24.

Efficiency of Dynamo Electric Machinery. WEINER. *Amer. Elec.*, July.—All the various formulas for calculating the several efficiencies of a dynamo are given. Tables are calculated for the ratio of shunt to armature resistance for different efficiencies, losses in dynamo belting, commercial, electrical and gross efficiency, average weight and cost of dynamos. The two last-mentioned tables are calculated for capacities of from one to 2000 kw and are stated to represent the average results for commercial machines. The writer says that in practice no definite law exists by means of which the weight, cost and efficiency of one machine being known, the same data for machines of other sizes may be calculated; among the reasons given are that machines of different capacities are not all built in linear proportion to each other, but in order to economize material, tools and patterns, the outputs of two or three consecutive sizes are often varied by simply increasing the length of the armature and pole pieces; the conductor velocity as a general rule is higher in larger machines; certain sized machines being more popular than others, they can be turned out in larger numbers and thereby their cost decreased; large generators frequently are fitted with special parts which lower the weight and efficiency and increase the specific cost; up to a certain point a bipolar type is employed and between the largest bipolar and the smallest multipolar there is a sudden jump in both the weight efficiency and the specific cost.

Burned-out Armature Coils. WOOLSTON. *Amer. Elec.*, July.—An instance is related where much trouble was experienced from burned-out armatures, which was finally traced to defective lamps on the line; some of these lamps, when the carbon was almost consumed, would allow the arc to change so rapidly that the regulators on the dynamos could not work fast enough, and an arc would form clear around the commutator; when the lamps were overhauled and put in shape there were no more burn outs; the bad performance of some of the lamps was found to be largely due to worn rods. The writer considers it impossible to lay down any rule for the care of commutators, for the reason that the material differs so largely with respect to hardness and softness; when some of the segments are hard and others soft, the only way to keep the machine running properly is by the frequent use of sandpaper.

Care of Electrical Machinery. BAXTER. *Power*, July.—An illustrated article showing the cause of short circuits in armatures and how to guard against them; it is of a practical nature.

Dynamo Characteristics. STINE. *Amer. Elec.*, July.—Instructions, together with diagrams of connections, are given for determining the characteristics of compound-wound dynamos; the various curves are discussed and the causes of peculiarities pointed out.

Construction of Armature Coils. BAXTER. *Amer. Mach.*, July 1.—An illustrated article of a practical nature on the construction of multiple-armature coils, which are wound on a form and then mounted in their position on the core.

Design of a One-quarter-hp Motor. POOLE. *Amer. Elec.*, July.—Instructions with working drawings for the construction of a small motor with a drum armature.

LIGHTS AND LIGHTING.

Effect of Light on the Eyes.—Cosmos, June 12.—A note stating that Kotz measured the amount of fatigue produced on the eye by different kinds of artificial light, by counting the number of winkings of the eyelids in 10 minutes; for the candle he obtained 6.8 per minute, for ordinary gas, 2.08; for sunlight, 2.2, and for the electric light, 1.8; all lighting causing more than three per minute ought to be rejected; (it is not stated what the eye was looking at when the measurements were made; it certainly could not have been the source itself.)

Electric Fountain. RENWELL. *Amer. Elec.*, July.—An illustrated description of the electric fountain at Willow Grove, near Philadelphia, a park which has been laid out by the Union Traction Company in order to increase its traffic receipts. By means of combinations of different jets and nozzles, at least 30 variations of water effects are secured; there are 15 8000-cp, 40-ampere focusing lamps used in illuminating the jets. The fountain pump has a capacity of 1000 gallons per minute and is driven by two 75-hp railway motors, an average pressure of about 40 pounds being maintained, which can be raised to 100 pounds.

POWER.

Wanau Power Station. PETAVEL. Lond. *Elec.*, July 2.—A brief description of this station, which is one of the largest in Switzerland; it is said to have been constructed in a very perfect manner; power is to be distributed over a very large area; 8000 volts are to be used; the river is capable of furnishing 3000 horse-power; there are five turbines of 750 horse-power each, and these are geared with three-phase alternators generating 450 volts, which are transformed up to 8000 for transmission; the same transmission is used for both light and power.

Transmission of Power.—Lond. *Elec.*, July 2.—A reprint from the Lond. *Engineer* commenting on the recent discussion before the Institution of Civil Engineers, which it is said was somewhat disappointing; while not favoring electric transmission throughout, it admits that in a number of cases that system is the best.

Very Long Distance Transmission.—Eng. News, July 8.—A note stating that a contract has been signed by the Southern California Power Company for an 80-mile transmission which is the longest distance on record, the next one to it being 36 miles for the Salt Lake City plant, in which only one-fourth the power is transmitted at one-third the line pressure used on the Niagara Falls-Buffalo transmission. The power station is 12 miles from Redlands; there will be four three-phase generators of 750 kw each, directly connected with impact turbines; 250-kw transformers will raise the pressure to 33,000 volts.

Transmission of Power Near Ogden, Utah. GOLDMARK. *Eng. News*, July 8.—A long abstract with illustrations, of a paper read before the American Society of Civil Engineers giving a complete description of this plant; the present abstract refers chiefly to the civil engineering features.

Electrically Driven Plowing Tackle.—Elec. Eng., July 8.—An abstract, with the illustrations, of the article noticed in the *Digest*, last week.

TRACTION.

Deri Traction System. Lond. *Elec.*, July 2.—An editorial discussion of the alternating-current accumulator system which was described in the *Digest* last week. A commendable point is the equalization of the load on the line; it is thought that the advantages have already been claimed by other methods which are far simpler; among the disadvantages are the use of two separate and distinct motors, each one of which should be sufficiently strong to do all the heavy work alone; there is a lack of flexibility; the design of the shunt-wound motor will be difficult and all the driving wheels cannot be used for adhesion; more skilled motormen will be required. In conclusion, the system is thought to be ingenious, but it is not thought that it would turn out to be a practical solution of the difficulties of electric traction. A description of the system is given in the same issue, accompanied by a diagram of the connections.

Shunt Motors for Railways. Egger. *Elek. Zeit.*, June 24.—A contribution to the recent discussion in that journal concerning this subject. It is a common mistake to suppose that the shunt motor has a smaller starting torque; this depends on the various factors, which may be so chosen that the starting torque is quite ample; as a proof of this he states that his company in Vienna have used shunt motors for railways exclusively during a number of years; in spite of their low speed, 450 to 600 revolutions, they weigh only 280 kg, their power for continuous load being 3.5 horse-power; with a normal load, the starting torque is 2.5 times the normal. He then discusses at length the advantages of a variable speed gear but admits that there is no practical form in existence; regarding the bad sparking when the field circuit is open he states that this can easily be avoided by an inductionless connection, such as he described a number of years ago, and which is in use on many hundred motors, in which not a single accident due to that cause has happened. He therefore believes that there is a future for shunt motors, although not with the arrangement recently described by Baxter.

Accumulator Traction in Frankfort.—Elek. Zeit., June 24.—A brief description. The alternating current from the central station is transformed into a direct current by means of motor dynamos; each car contains 84 cells, of a capacity of 120 ampere hours at a five-hour discharge; the total weight of the battery is about two tons and of the empty car eight tons; the cells are charged at the end station in four to five minutes through a contact at the top of the car and therefore without removal of the cells; the charge is such that an additional charge of half an hour during the night is sufficient for running them all day.

Electricity on Steam Roads.—Elek. Zeit., June 24.—A brief description of the line from Burgdorf to Thun (Switzerland). The water-power plant has a capacity of 2500 horse-power; the motor cars will be equipped with 200 horse-power and will be capable of drawing trailers; the locomotives will have 360 horse-power and will, as a rule, be used for freight only.

Lachmann Conduit System.—Lond. *Elec.*, July 2.—A well-illustrated description of this system, which has been referred to frequently in these columns, the characteristic feature being an inverted channel-shaped conduit in which the conducting wire is held so that, if the conduit is flooded with water, the air confined in the channel will not let it rise as high as the wire; the contact shoe leaves the wire near the end of each section of the channel, and passes into the next under a bridge piece; the depth of the conduit is no greater than that of the track itself.

Recent Developments in Electric Traction Appliances. Baylor. *Jour. Inst. Elec. Eng.*, June.—A reprint of the complete paper, with discussion, which was noticed in the *Digest*, April 24, May 1, 8 and 15, and June 12.

Generation of Electrical Energy for Tramways. Raworth. *Jour. Inst. Elec. Eng.*, June.—A reprint of the complete paper, which was noticed in the *Digest*, May 15 and June 5.

Monorail System.—Lond. *Eng'ing.*—The conclusion of the description of the Behr system, including large working drawings.

Losses from Stoppages of Electric Cars. H. S. Hering. *Amer. Elec.*, July.—The results of a large number of tests are summarized on the relation between the amount of energy required to propel an electric car and the number of stops made during the trip; it is shown that the cost of one stop on each trip of a car during a year on a 15-car road may amount to $70, or to $467 for a 100-car road; by a careful handling of the controller a saving of over $1000 per year may be made on a 15-car road and $7000 per year on a 100-car road; the difference between two ordinary motormen making the same trip under similar conditions is from 3 to 8 per cent., and it is perfectly safe to take 10 per cent. as the amount of energy that can be saved by more careful handling of the controller, while on most roads at least 15 per cent. could without doubt be saved; the maxim of every motorman should be: "Use the brakes as little as possible and drift as much as possible."

Electric Hansoms in New York. Dolnar. *Am. Mach.*, July 8.—A brief illustrated description of the cabs, of which 12 are in regular service in New York City and which, it is said, are already profitable, although the rates are the same as those for horse-drawn cabs. The front of the carriage is open and quite low; the batteries weigh about 1000 pounds and require eight hours for charging; the total weight is 2500 pounds; it takes but a few minutes to change the batteries, of which there are two sets for each carriage; it will run about 24 miles on the level without changing batteries; there are two motors secured to the front wheel axle, and weighing 150 pounds each, being rated at 1.5 horse-power; they are series wound and are controlled by the series-parallel method.

Motor Vehicles.—Eng. News, July 1.—An editorial discussion with special reference to some of the recent prize contests. It is thought that the most successful ones are those propelled by volatile fluids as fuel; notwithstanding the advantages of accumulators, it is thought that the gasoline motor is still the best; but the storage battery would undoubtedly have the preference if the durability and maintenance of the cells and motors could be reduced to a par with those of the gasoline apparatus.

Effects of Low Voltage on Motor Circuits. Cleveland. *Amer. Elec.*, July.—The running time on roads being made out on a 500-volt speed basis, if there is a large drop in the voltage at any time or place, it is necessary in starting for the motorman to throw the controller handle around much faster than would be necessary if the voltage were normal, thus giving the speed no chance to respond to the increase in current; this, together with the fact that more current notches must be used when, under proper conditions, the car should be coasting along with the current off, results in increasing the average daily current and heating the motors abnormally.

Application of Electricity to Steam Railroads. Brangs. *St. Ry. Jour.*, July.—A reprint of a paper read before the American Railway Association. A general discussion favoring electric traction and its partial substitution on steam roads with special reference to suburban traffic and the running of small branches on tracks and with cars which are the same as those of the main road; he sees no reason why electricity and steam would interfere if used on the same road; he quotes largely from a recent article by Baxter; he does not seem to have brought out any new points.

Railway Practice in Europe.—St. Ry. Jour., July.—A long, well-illustrated article describing quite a number of electric railways in Europe and a few in other foreign countries, some of which show features differing from those usual in this country, among which are the side trolley, track construction, wire supports, etc.

Railway Motors. Hanchett. *St. Ry. Jour.*, July.—The beginning of an article of a practical and to some extent elementary nature; in the present portion the various forms of field magnets, and their properties, are discussed.

Power Station Design.—St. Ry. Jour., July.—An editorial discussing the station in Chicago about which there has been so much controversy.

Power Station Switchboards. Moffat. *St. Ry. Jour.*, July.—A short illustrated article on the erection of such switchboards.

Financial Results of Cable and Electric Railways.—St. Ry. Jour., July.—The continuation of the comparative results of some typical lines in the United States, accompanied by curves.

Repair Shop.—St. Ry. Jour., July.—An illustrated description of the one connected with the Brooklyn Heights Railway.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Shoreditch.—Lond. *Elec. Eng.*, *Elec. Rev.*, *Eng'ing*, July 2, and *Lightning*, July 1.—A description of this municipal station. The first and last journals mentioned contain a long illustrated description, that in the other two being more brief. It is of special interest, as the power is generated from the refuse of the city; it is said to have completely demonstrated the fact that it is possible to raise high-pressure steam by burning the town's refuse; the intention is to use refuse only, although it seems that some coal is now used in addition. In combination with the refuse destructors the Halpin thermal-storage system is used (in that system large quantities of hot water under high pressure are stored ready to deliver steam when called upon); besides this the electric energy is stored in accumulators. It is anticipated that the most efficient rate of working of the destructors will be found to lie between 8 and 10 tons per cell per day; the lighting system is that known as the Oxford, in which a high-tension direct current is used; at present the plant consists of three direct-coupled generators of 160 kw running at 1100 volts and three dynamos of 70 kw each of 165 volts. The opening ceremony took place a few days ago, Lord Kelvin formally turning on the current; in his address he said this undertaking was an example of the combination of scientific forethought, mechanical skill and courage; it was only the beginning of what would be a much greater thing.

Central Station Accounts.—Lond. *Elec. Eng.*, July 2.—An analysis of the accounts of the Sunderland and Belfast stations. Attention to the former is called in an editorial note in the Lond. *Elec.*; it shows the necessity of guarding against unprofitable extensions; although the increased output was over 50 per cent. the revenue per lamp has fallen and the cost at the works has risen, although the tariff was reduced.

Automatic Regulator for Constant Potential. Collischoun. *Elek. Zeit.*, June 24.—An illustrated description of a form of regulator for shunt machines devised by him. It consists essentially of two magnets operating make-and-break contacts, one operating when the potential is too high, and the other when it is too low; when in action their armatures vibrate, and in doing so move a circular resistance coil in which the con-

tacts are changed by means of a little mercury in the inside; the regulation is said to be accurate to half a per cent.

Rectifier. POLLAK system. *Elek. Zeit.*, June 24.—A brief description from a patent, of a new form. It is based on a liquid condenser of large capacity, made of aluminum plates which have been formed in an alkaline solution; such plates have a large capacity, and a condenser of this kind can be used up to 110 volts per cell; if one of these plates is replaced by one of another metal, say of lead, the cell will have the property of allowing a current to pass in one direction, but not in the other; when connected with an alternating-current circuit it will therefore allow only a direct current to pass through. The circuit is arranged in the form of a square, the four corners of which are connected to four wires, the first and third of which go to the alternator and the second and fourth to the continuous current; two cells have their lead plates connected to the second wire, and the other cells have the aluminum plates connected to the fourth wire; the apparatus thus acts like the four valves of a double-acting air pump.

Influence of Synchronous Motors on the Power Factors of Three-Phase Stations. KLASSON. Lond. *Elec.*, July 2.—A translation in abstract of the article noticed in the *Digest*, June 5.

Cost of Electrical Energy. HERRICK. *Elec. Eng.*, July 8.—The first part of a serial in which he calls attention to the unsatisfactory form of most published accounts of costs, and intends to describe a proper system of preparing such tables of costs.

Central Station Economies. BABCOCK. *Elec. Eng.*, July 8.—A short article in which he calls attention to the importance of continuous utilization of the power of a central station, and believes the problem can be solved, in both lighting and power stations, by the utilization of exhaust steam.

Columbus State Hospital Plant. ROBERTS. *Amer. Elec.*, July.—An illustrated description of the new lighting and power plant of the Columbus, Ohio, State Hospital, including a plan of the wiring and a table of the material used. Two 40-kw and one 20-kw direct-connected dynamos furnish current for 1600 incandescent and 10 arc lights. All the concealed wiring is in circular loom conduit and laid down on the loop system.

Municipal Plant at Hamilton. GRAY. *Elec. Eng.*, July 8.—An article on this plant, favorable to municipal lighting, and written in reply to a recent one by Bean, who took the opposite views.

WIRES, WIRING AND CONDUITS.

Municipal Aid to Wiring. GIBBINGS. Lond. *Elec. Eng.*, July 2.—A reprint of a short Municipal Society paper. He enumerates the various inducements to be offered for increasing the demand for electricity, such as free service wires, abolition of meter rents, free supply of lamps, hiring motors, reduced price for power current, etc.; the main question with municipal stations seems to be the difficulty of securing powers and capital for such additions; he suggests accomplishing it through the medium of an independent company, although he considers it more desirable that the municipal corporation should have complete control of such plants. In the discussion, Pearson remarked that the wiring contractors in the city were the best unpaid canvassers for electric light that the corporation could have; Barnard said that municipal wiring was tried in Hull and the result was very bad; Miles thought municipal wiring would avoid the "jerry" work, so much of which was done in connection with the wiring; Richards stated that in Bedford customers could exchange old lamps for new ones free of cost every quarter as a rebate on prompt payment; this prevents them from buying bad lamps and laying the blame on the lighting station.

Electric Wiring in Powder Magazines—Lond. *Elec.*, July 2.—An abstract of the article noticed in the *Digest*, last week.

Distributing Systems. JECKELL. *El'ty*, June 30.—A paper read at the Municipal Association at Manchester. He admitted that there is no one method which is the best, but that each case must be considered by itself; that which offers the best value for the money and not that which happens to be the lowest price should be chosen; the part beyond the switchboard should be the very best procurable. He compares the low and high tension direct system and the high tension alternating and then discusses the various systems of underground mains.

Calculating Circular Mils of Conductors. PARNELL. *Amer. Elec.*, July.—Knowing the size of one wire the circular mils of the next larger size may be obtained by multiplying by 1.261 and of the next to this by multiplying by 1.59; the circular mils of the next size smaller are found by multiplying by .793 and by .629 for the second size smaller.

Incandescent Lamp-Switch Circuit. CONNAUGHTON. *Amer. Elec.*, July.—A circuit with two two-way switches, so connected that incandescent lamps can be turned on or off independently of each other.

Interior Wiring.—Amer. Elec., July.—Various methods of overcoming difficulties in running concealed work are described and illustrated.

ELECTRO-PHYSICS AND MAGNETISM.

Nature of Röntgen and other Rays. PRECHT. Lond. *Elec.*, July 2; abstracted from the *Wied. Ann.* 61, p. 2.—An elaborate paper on the comparison of Röntgen and other types of radiation. He described photographs showing that the bending of cathode rays in a magnetic field is strictly in accordance with the Biot-Savart law, and the theory of electrodynamic tension; the canal rays are not deflected by a magnet and have no power of exciting fluorescence or photographic action; Röntgen rays can alter the resistance of the selenium cell 32 per cent.; the amount of absorption by paper subjected to Röntgen rays depends upon the time during which the radiation lasts; he thinks a portion of the action is purely electrical; experiments were made with interference and some data were obtained corresponding to a frequency of light, pointing to the fact that the radiations may be longitudinal rays.

Luminescence by Various Rays. ARNOLD. *Wied. Ann.*, 61, p. 313; abstracted in the Lond. *Elec.*, July 2.—A systematic investigation of luminescence produced by all sorts and conditions of rays, including light, cathode, Röntgen, Becquerel, canal, and discharge rays; a number of substances were also examined; among the results was a proof that the effects obtained with solid solutions cannot be obtained by a mere intimate mechanical mixture of the two substances; there is a more decided difference in the luminescence of various bodies under the influence of cathode and X-rays respectively. Most brilliant solid solutions fail to produce Becquerel rays; the canal rays obtained by Goldstein from the red cathode rays by perforating the cathode, are not deflected by a magnet, but have the property of producing an intense luminescence which is only temporary, as the bodies rapidly lose this property under their influence; there is no photographic action; their energy is very great; it is thought that luminescence may offer a valuable test for distinguishing between the various types of rays.

Penetrative Power of X-Rays for the Alkali Metals. MARANGONI. *Proc. Lond. Phys. Soc.*, June; abstracted briefly from the *Rend. Acc. Linc.*, 5, p. 403.—He found that the thickness of sodium was double and of lithium twenty times that of potassium to produce the same depth of shadow; lithium is therefore the most transparent of any of the metals; the alkali metals are therefore exceptions to the general rule that the transparency is inversely proportional to the density; it seems rather a function of the atomic weight.

X-Rays in 1708.—Cosmos, June 12.—Under this heading a translation is made of an article in the *Philosophical Transactions* of 1708, by Hawksbee, describing some experiments in which opaque objects were to a certain extent made transparent by means of what appears to have been a static charge effect; the matter seems to have no connection with X-rays.

Researches with Uranium Rays. BECQUEREL. *Jour. Inst. Elec. Eng.*, June; abstracted briefly from the *Comptes Rendus*, March and April.—Two papers, one on researches on uranium waves, and the other on the law of discharge of electrified uranium in air.

Lecher System. APT. Lond. *Elec.*, July 2; abstracted briefly from the *Wied. Ann.*, 61, p. 293.—A systematic investigation of the law governing the distribution of the electric waves along the Lecher wire system.

Zeeman Effect. ZEEMAN. Lond. *Elec.*, July 2.—An abstract from the Proceedings of the Royal Academy at Amsterdam describing some additional observations of the same nature as those recently published by Lodge; a doubling and tripling was observed in the blue-green cadmium light.

Theories of Residual Electricity. HOULLEVIGUE. *Proc. Lond. Phys. Soc.*, June; abstracted briefly from the *Jour. de Physique*, 6, p. 113.—A very long abstract of a mathematical paper, in which he discusses Maxwell's theory in connection with an explanation of a certain imperfect agreement between theory and practice.

Steady Motion of an Electrified Ellipsoid. SEARLE. Lond. *Elec.* and *Elec. Eng.*, July 2.—An abstract of a Physical Society paper of a mathematical nature, showing the principles required in the solution of problems with respect to moving electric charges.

Electrical Heating of Condensers. HOULLEVIGUE. *Proc. Lond. Phys. Soc.*, June; abstracted at length from the *Jour. de Physique*, 6, p. 120.—He states that heating occurs only with dielectrics which show residual phenomena, and then establishes theoretically for a perfect condenser the theorem that if the dielectric constant increases with the temperature the condenser is cooled on charging and heated during discharge, while the reverse is the case if the dielectric constant decreases as the temperature rises.

Temperature and Electric Discharge. PANDOLFI. *Proc. Lond. Phys. Soc.*, June; abstracted from the *Nuovo Cimento*, 5, p. 89.—A description of experiments. Among other things he found that the resistance between dissimilar electrodes is not the same in both directions, being less from a point to a disc than in the opposite direction.

Discharge Produced by a Spark. SWYNGEDAUW. *Comptes Rendus*, March; abstracted in the *Jour. Inst. Elec. Eng.*, June.—A discussion of the question of temperature and oscillations with reference to the working of the Herz exciter.

Liquid Coherers and Mobile Conductors. APPLEYARD. *Proc. Lond. Phys. Soc.*, June.—A reprint of the complete paper, with the discussion, which was noticed in the *Digest*, April 17.

Thermoelectric Properties of Liquid Metals. BURNIE. *Proc. Lond.*

Phys. Soc., June.—The beginning of a reprint of the complete paper which was noticed in the *Digest*, March 20.

Heating of Conductors by Alternating Currents. Guye. *Proc. Lond. Phys. Soc.*, June, and *Jour. Inst. Elec. Eng.*, June.—An abstract giving some of the formulas of the article noticed in the *Digest*, May 22.

Resistance of Conductors to a Variable Current. Brylinsky. *L'Eclairage Elec.*, June 26.—The first part of a long mathematical paper in which he gives a complete discussion of the subject of the ohmic resistance, the consumption of energy, etc.; he bases it on the four quantities, the static resistance, the static self-inductance, the effective resistance and the effective self-inductance.

Atmospheric Potential Gradient. Cadet. *Proc. Lond. Phys. Soc.*, June, and *Jour. Inst. Elec. Eng.*, June; abstracted from the *Comptes Rendus*, 124, p. 761.—The observations were made from a balloon to test a new form of collector, consisting of a piece of paper impregnated with lead nitrate and lighted; it was lowered from the car by a wire attached to the electrometer; the experiment was satisfactory.

Atmospheric Electricity. Cancani. *Proc. Lond. Phys. Soc.*, June; abstracted briefly from the *Rend. Acc. Linc.*, 1, p. 112.—A continuation of a previous paper containing comparisons of daily observations in an Italian observatory.

Apparatus for Illustrating Polyphase Currents. Wurstemberger. *Beiblaetter*, 3, p. 258; abstracted briefly in *Jour. Inst. Elec. Eng.*, June.—It consists of three pumps pumping into a common reservoir, the delivery or removal taking place according to the sine law; when in the proper phase there is no change in level.

Pressure Coefficient of Mercury Resistance. Palmer. *Am. Jour. of Sc.*, July.—An article describing the redetermination of the variation of the specific resistance of mercury under different pressures; previous determinations did not agree; his experiments were extended over a large range of pressures obtained with screw compresser; the results are given in curves and tables; the resistance measurements are accurate to less than one-tenth of 1 per cent.; he obtains the formula that the resistance at any pressure is equal to that at zero, multiplied by $1+bP$, in which P is the pressures in atmospheres, and b is the increment to the unit resistance caused by one atmosphere increase of pressure; the mean value of b is given as $-0.0000332-5\times10^{-9}t$, in which t is the temperature in centigrade degrees; this result agrees very well with that of Barus.

Alternating Current Lag.—Amer. Elec., July.—An explanation is given of alternating current lag. A comparison is made with a continuous-current motor, an inductance in an alternating-current circuit being, like such a motor, a generator of counter E.M.F. The impressed E.M.F. of the motor is the sum of the free and counter E.M.Fs; in the latter case, the impressed E.M.F. is similarly the sum of the counter or inductive and the free E.M.F. The current flowing through an inductance is always in phase with the free E.M.F.; on the other hand, the impressed E.M.F., being the resultant of the inductive and free E.M.Fs, is out of phase with the latter, for the reason that the inductive E.M.F., being 90 degrees out of phase with the free E.M.F., when combined with it gives an impressed E.M.F. out of phase; the angle of lag corresponds to the amount by which the free and impressed E.M.F.s are out of phase, and as the current is in phase with the free E.M.F. it also corresponds to the amount by which the current and impressed E.M.F. are out of phase.

Polarization Capacity. Gordon. *Am. Jour. of Sc.*, July; abstracted briefly from the *Wied. Ann.*, 5, p. 1.—He gives an historical discussion followed by results obtained by him with the Nernst method; his results do not agree with those of Wien; the former found that Kohlrausch's law holds very exactly.

Electrified Matter. Tyler. *El'ty*, July 7.—The beginning of a serial intended for amateurs, students, and more especially for the medical profession, in which he intends to give the underlying principles of the science dealing with electricity, departing somewhat from the usual style of text-books. He claims that the electrician has to deal only with a condition; that in electrification there is no addition, removal or transportation of any substance; that "whatever manifestations occur in electrified matter are accomplished through the lessening of cohesion of the particles of the affected bodies"; he intends to give true definitions of the terms; he defines the volt as the unit of the effort to electrify, the ampere as the unit of degree of electrification, and the ohm as the unit of persistency to maintain compaction; he deals with the general case, of which dynamic phenomena are only special cases.

X-Ray Burns. Sharpsteen. *Elec. Eng.*, July 8.—A detailed description of two serious cases, from which he concludes that the harmful effect is due to the pulsating current; that if proper treatment had been pursued at once the skin would have become sound again; and that the health of a person has something to do with the effect produced.

Application of Röntgen Rays to Surgery.—Am. Jour. of Sc., July; abstracted briefly from the *Comptes Rendus*, May 17.—Ollier describes his researches on the osseous regeneration after surgical operations; observations heretofore have been very difficult, but X-rays now enable one to study the development exactly, rendering unnecessary, in certain cases, the amputation of diseased limbs, since the diseased portions can now be accurately located and removed.

ELECTRO-CHEMISTRY AND BATTERIES.

Cleansing Bath.—Elek. Anz., June 20.—A note stating that Jordis has found that lactic acid or its salts, especially with ammonia, forms a very good material for cleansing metallic articles before plating, especially in cases where potassium cyanide is now used, as with the softer metals, copper, brass, etc., or when there is a high polish; the lactic acid removes the oxide without attacking the metal, and no harm is done if some of it gets into the plating bath.

Electric Absorption of Nitrogen by Carbon Compounds. Berthelot. *Comptes Rendus*, March; abstracted in the *Jour. Inst. Elec. Eng.*, June.—A new series of experiments to define more particularly the absorption of nitrogen by carbon compounds and the influence of the electric discharge; some of the results are given in the abstract.

Thermo-Electric Batteries. Reed. *Amer. Elec.*, July.—A reply to criticisms of Anthony and Case on an article which appeared in a previous number. In reply to a claim by Jacques that his cell is enclosed in a uniformly heated chamber, it is said that the current of air continually blown into the cell would certainly nullify this condition unless the current of air were previously heated to exactly the same temperature, and Jacques does not state whether this was done. Admitting that all the materials within the enclosure might have been originally at the same temperature this uniformity of temperature could not remain undisturbed while a strong electric current was flowing through the apparatus, owing to Peltier and Thomson effects, which in this type of cell are very powerful. He considers that the burden of proof lies with those who claim that all parts of the Jacques apparatus are, or could be, maintained at the same temperature. Comparing the Daniell and Jacques cell it is stated that while in the former the chemical reaction alone must necessarily evolve energy, in the Jacques cell the chemical reaction alone must necessarily absorb energy. He does not consider it proved that the Jacques cell is an exception to the universal rule that in all galvanic or electrolytic cells chemical action takes place at both electrodes. In answer to Anthony's statement that the operation of the Jacques cell does not require a continuous application of heat, but only requires that the temperature shall be sufficiently high, he says that this applies also to any other thermo-electric couple, for if all the parts of such couples be raised to a sufficiently high temperature there is only required for the operation of the cell, application of a current of cold air to the junction, such as is employed in the Jacques cell. Anthony having suggested that if we happened to be living at the high temperature at which the Case cell gives an electric current, that cell could be maintained in action by renewing the materials as they are consumed, exactly as we now renew the materials of a gravity cell, Reed replies that a gravity cell is renewed by putting in materials that contain chemical energy and removing materials from which the available chemical energy has been exhausted, while Case would renew his materials by the simple act of cooling them, that is, by abstracting more energy from them, which would constitute the cell an inexhaustible source of energy. Replying to Case he states that no researches have been published indicating that carbon may be oxidized at low temperatures without expending upon it, in some form, more energy than could be derived from it; if Case obtained and measured as much as a single watt-second of electrical energy and proved that it came from the carbon he did not publish the proof, nor state how much carbon was consumed in the operation.

Electricity Direct from Carbon. Helleeg and Hall. *Rose Technic*, June.—A short article in which, after briefly reviewing the subject, they give the results of their investigations of a cell which is said to closely resemble that of Jacques; (the figure referred to was not published); the object was to decide some of the points of contention regarding the true source of energy in that cell; they made several tests which are claimed to be exhaustive and obtained results which they consider conclusive; these are, that the oxygen of the air is absolutely essential to the maintenance of a steady voltage; that illuminating or nitrogen gas in place of air is destructive to the life of the cell and lower the voltage to nearly zero; that the oxygen is taken from the air to burn the carbon, which was proved by an accurate quantitative analysis of samples of "air" collected after having passed through the cell. Unfortunately the experiments came to an end just as they had arrived "at a most interesting stage of the investigation, that of obtaining the efficiency of the cell;" nothing but their conclusions are given.

Manufacture of Chloride of Potash at Niagara Falls. Overbury. *Cassier's Mag.*, July.—A very short illustrated article describing the plant in which the Blumenberg process is used; this plant is said to be the first one to manufacture chloride of potash in the United States; the description of the electrolytic portion of the process is very brief.

Electro Synthesis. Mixter. *Am. Jour. of Sc.*, July.—A long article describing experiments with the chemical union effected by means of electricity in the form of a discharge; this he distinguished from the union caused by the heat of the discharge; it refers chiefly to experiments with oxygen, hydrogen, and the hydro-carbons.

Synthetic Action of the Dark Discharge. Losanitch and Jovitschitsch. *Am. Jour. of Sc.*, July; abstracted briefly from the *Ber. Berl. Chem. Ges.*, Jan.—A brief description of an extended series of experiments in which they used the Berthelot ozonizer.

An Improved Battery Jar. RANDALL. *Amer. Elec.*, July.—A jar with a slight depression in the centre of the bottom to hold zincs in place, and also to contain a few drops of mercury for the purpose of keeping the zincs amalgamated and clean.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Report of the Reichsanstalt. Elek. Zeit., June 24.—A continuation of the abstract of the report concerning last year's work (see *Digest* last week); the abstract consists mainly of a mere statement of what has been done and contains little matter of special interest. Concerning meters it was found that the principal cause of the error was the heating, which in 31 of the meters tested was between 3 and 6 per cent., and in the remaining 67 a mean of 2.1 per cent. Concerning measurements it is stated that in the Weston instruments, the construction of which is praised, the accuracy of the reading was in most cases greater than that required to receive a satisfactory report; in 11 of the instruments which had been in practical use and were returned for examination no change in the constant could be found. A high voltage accumulator of 8000 volts has been completed; also a 10-kw transformer of 36,000 volts. Of the 48 pieces of apparatus for foreign countries 19, which is the largest number sent to any one country, were for America. Measurements of resistance and magnetism are referred to, and the magnetic data for some of the best kinds of cast material are given; a comparison between magnetic homogeneity and electric conductivity has been continued, and it may now be safely concluded that whether a material is magnetically homogeneous may be determined readily by determining its electrical conductivity; no absolute connection between these two properties could be found; in annealing iron and steel rods made of homogeneous material, it was found that if by improper annealing the material had been made heterogeneous it cannot be again made homogeneous by a subsequent proper annealing.

Portable Photometer. PREECE and TROTTER. *Proc. Lond. Phys. Soc.*, June; abstracted from a French journal.—The observer faces a white opaque screen, and the light to be tested is placed in a fixed position behind him, but rather to one side, so that it may illuminate the screen; through an aperture in the latter a second screen is visible, which can be turned about a vertical axis at its right-hand edge, from a position in which it is parallel to the first screen, to one in which it is perpendicular to it; the standard light is placed in a fixed position in this parallel plane behind the first screen to the left. When therefore the second screen is parallel to the first it is illuminated, while when it is perpendicular to it it receives the full illumination of the standard light, and the fraction of the illumination it receives in intermediate positions is proportional simply to the cosine of the angle between the two screens. To compare the intensity of two sources of light the second screen is rotated until the position of it seen through the aperture appears neither lighter nor darker than the first screen. The apparatus is standardized once for all by testing a flame of known illuminating power against the arbitrary standard, and the only measurement required in subsequent determinations is therefore that of the angle between the two screens.

Galvanometer Independent of External Magnetic Fields. RAPS and FRANKE. *Beiblaetter*, 3, page 249; abstracted in the *Jour. Inst. Elec. Eng.*, June.—They describe methods for making a very sensitive galvanometer independent of a variable field such as from earth currents. One or two bundles of thin iron wires are brought nearer to the weaker magnets in a horizontal direction outside of the galvanometer so that the component lying along the axis of the bundles is strengthened; perturbations in one direction then have scarcely any effect, while those at right angles affect the sensitiveness but not the position of rest; in addition two auxiliary magnets are mounted on a moving system externally to the two moving magnets and are much lighter and weaker; by turning these the combination can be made perfectly astatic.

Improved Unifilar Magnetometer. WILD. *Proc. Lond. Phys. Soc.*, June; abstracted briefly from the *Acad. Imp. des Sc.*, St. Petersburg, 7, p. 1.—He describes a magnetometer to obviate the uncertainty as to the temperature and position of the deflecting magnet.

Ratio of Electrostatic and Electromagnetic Units. HURMUZESCU. *Proc. Lond. Phys. Soc.*, June; abstracted briefly from the *Ann. Chim. et Physique*, 10, p. 433.—He investigated the ratio giving the details of a method, together with historical references; the final constant was 3.001, with a probable accuracy of one in 1000; this differs from the value taken as the most probable for the velocity of light, namely, 2.998, by less than one in 1000.

Hookham Meter.—Lond. *Elec. Rev.*, July 2.—An illustrated description of the manufacture of these meters, which are used largely in England.

Measurements of Alternating Current Power. MCKISSICK. *Amer. Elec.*, July.—Diagrams are given showing connections for measuring power in single-phase, two-phase and three-phase circuits. In the first-mentioned case a watt meter alone is used, with or without a multiplier. In the two latter cases a wattmeter, voltmeter and ammeter are used, the number of instruments being reduced by means of an arrangement of switches; by throwing these in in consecutive order all the necessary data are obtained.

Faults, and How to Find Them.—Amer. Elec., July.—Several methods are given for calibrating a recorder wattmeter. One of these is to connect it in series with a volt and ammeter; the construction of an ice calorimeter and its use are explained for calibrating purposes.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Submarine Telegraph Receiver.—Lond. *Elec.*, July 2.—An editorial note describing a new instrument devised by Ader and described before the French Academy of Sciences. The recorder consists simply of a very fine wire 0.02 mm in diameter stretched between the poles of a powerful permanent magnet in an exceedingly narrow air space; a current sent through the wire moved it forward or backward and these oscillations are recorded photographically on a strip of paper which immediately afterward moves through a fixing bath. It has been tried on several French cables; on an Atlantic cable 600 signals a minute were obtained, as against 400 with the siphon recorder; on the Mediterranean cables signals were sent at the rate of 1600 per minute. The editorial suggests that it would be well to know the time elapsing between the photographing and the reading by the operator; it questions whether the developing bath would act reliably, also whether the signals are sufficiently distinct.

Seismology and Cables.—Lond. *Elec. Rev.*, July 2.—An editorial abstract of the recent paper by Milne, which was noticed in the *Digest* last week.

Telephone Receiver.—Cosmos, June 19.—A description of the Lallie receiver, in which there are two diaphragms, one of the usual kind and the other in the rear, and having fastened to it the cores and coils, which move in a slightly larger hole than their diameter, in the magnets; both the diaphragms therefore vibrate; although the price is low the instrument is said to be as loud as the best types used in France; the attraction is said to be stronger and the vibrations are increased in amplitude.

Telephone System in the United Kingdom. RAPHAEL. Lond. *Elec.*, July 2.—The first of a series of articles, the present being an illustrated description of the early history.

Recent Progress in Telegraphy. TOBLER. *Jour. Télégraphique*, June 25.—Brief descriptions of the Dejongh diplex system and of the Baudot relay.

Automatic Telegraphy. DELANY. *Elec. Eng.*, July 8.—The conclusion of his serial. He describes the many improvements embodied in his chemical system (his system has already been described in these columns). He gives as the ordinary speed of a translator of the chemically prepared tape 35 to 40 words per minute, or about twice that when received by sound on the average Morse; a typewriter will translate twice as fast as a sound receiver, thus involving a saving of one operator in three; in comparison with the quadruplex this system would mean 50 to 100 phantom circuits, according to distance; he discusses and replies to the objections which have been raised to this system; the speed may reach 3000 words per minute or 1000 for 1000 miles with one ohm per mile of wire; he shows the effect of a consequent reduction in price of messages; in his system one wire would be equal to 100 Morse circuits, 50 duplexes, 25 quadruplexes or seven Wheatstone duplexes; repeaters are not necessary even on the largest circuits; a wire of 850 pounds of copper per mile between New York and San Francisco, with about one-eighth the total electrostatic capacity of the Atlantic cable, should yield at least 250 words per minute using 300 volts.

The Relay and Its Relation to the Telegraph Circuit. LOCKWOOD. *Elec. Rev.*, July 7.—The beginning of a reprint of a paper read before the Association of Railway Telegraph Superintendents; it is supplementary to a paper by Fry on the reduction of relay resistance, read before that association last year; in the present portion he describes the telegraph relay.

Photographic Printing Telegraph. EATON. *Elec. Eng.*, July 8.—An illustrated description, taken apparently from a patent specification, of a system in which the printing is done by means of instantaneous photography, and it is claimed that a speed equal to that of the chemical telegraph can thereby be obtained.

Isolated Telephone Lines. MILLER. *Amer. Elec.*, July.—Various forms of grounded and metallic-circuit lines are described and illustrated, including bridged, grounded and metallic circuits. Referring to bridged lines, it is said that so little voice current finds passage through the various paths afforded from one side of the circuit to the other by permanently bridged call bells, that an almost unlimited number of instruments may be used in a single line with good talking results, the practical limit being reached when the generator will no longer furnish enough current to ring all the bells.

Private Telephone Construction. SMITH. *Elec. Eng.*, July 8.—The first part of a serial in which he gives some hints regarding the wiring, with special reference to a specific kind of wire, and then begins a description of the systems, in private plants, in which no switchboard is used.

MISCELLANEOUS.

Union of Electrical Engineers of Germany.—Elek. Zeit., June 24.—An editorial review of the proceedings of the recent annual meeting at Eisenach. The attendance was very small; among the reports was one on rules and regulations for high tension installations, but it was agreed at the suggestion of the committee not to adopt any rules until more experience has been had; it was agreed that the committee should report again in two years, during which time it should gather additional information. The

report on incandescent lamps was not accepted as conclusive and the time of the committee was extended for another year; regarding the method of testing the lamps photometrically it was decided to adopt the method of Heller (see below). The conclusions regarding photometric units (see *Digest*, June 19), were adopted. A committee was appointed to report on a standard form of Edison screw socket for incandescent lamps. The papers are not abstracted, but they are very highly spoken of; the next meeting is to be held in Frankfort.

The Lond. *Elec. Eng.*, June 25, continues its account of this meeting, referring chiefly to the social features. Among other things the committee on Incandescent Lamps recommend the incandescent lamp as a standard for photometric purposes; the arrangement suggested by Heller is illustrated; it consists essentially in running the standard and the lamp to be tested in multiple, each with its own rheostat, so that slight fluctutations in the voltage will affect both equally; the standard lamp is placed in front of two reflectors at right angles to each other, so that the angle of the filament does not so seriously affect the results.

Municipal Electrical Association.—Lond. *Elec. Eng.*, and *Elec. Rev.*, July 2.—The former journal contains a full report of the second annual convention at Manchester, including the presidential address by Wordingham, in which he indicates some of the directions in which the association may increase its sphere of usefulness; also two papers on the generation of steam, by Snell and Steinitz, with the discussion. Also a paper on municipal aids in wiring, by Giblings, which is noticed under a special heading. The latter journal contains the address in abstract and the two first papers in full.

A New Use of Calcium Carbide.—Cosmos, June 19.—An Academy paper, by Chuard, in which he shows that after the acetylene has been evolved there is a production of ammonia, and that therefore the residues form a good fertilizer; experiments have also shown that they are useful as an insecticide; experiments are being made at present in Spain with the phylloxera, the action being thought to be due to the phosphoretted hydrogen which is generated, due to the impurities; in the experiments the amount of this impurity was intentionally increased.

Forecasting the Progress of Invention. Baxter. *Pop. Science Mo.*, July.—An article on the possible future progress, referring chiefly to the utilization of energy and including some reference to electrical energy direct from coal, in connection with which he expresses the belief that progress in this direction will be more likely to revolutionize the affairs of the world than the utilization of the natural forms of energy.

Municipal Government. Flower and Pavey. *Forum*, July.—Two articles on non-partisanship in municipal government.

Biographical.—West. Elec., July 10.—A biographical sketch, with portrait, of the late Henry B. Stone, who lost his life by accident, July 5; it is said that he was for seven years the most influential exponent of the Bell Telephone interests in the West.

Educational. Paulsen. *Forum*, July.—The first part of an article on the evolution of the educational ideal.

Economic Automatic Engines.

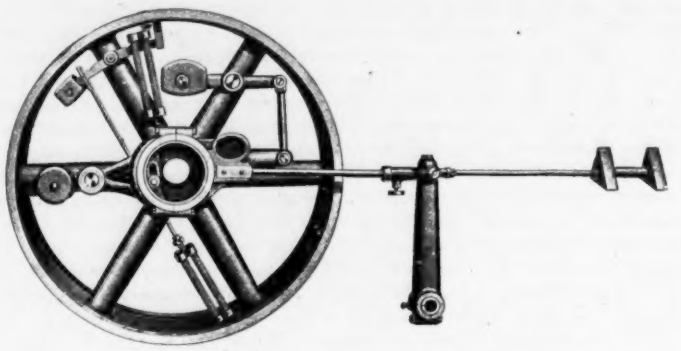
The modern steam engine for electric light and power work exemplifies the important fact that whenever a demand arises for improvement in a machine or a process, the requirements are sure to be met, and it is an excellent commentary on the skill and training of engineers and technicians to be able to meet any extraordinary conditions that are presented in the evolutionary process of an industry. This is especially true with reference to electrical and steam engineering, and the perfect steam engine of to-day is to a great extent the result of necessities brought about in the development of electrical engineering.

Many excellent steam engines are now made that meet the exact requirements of electrical practice, and for close and quick regulation under all conditions of load little more can be desired. One of these is the "Economic" automatic engine, manufactured by the J. B. Allfree Manufacturing Company, Indianapolis, Ind. This concern makes a specialty of electrical and condensing work, and produces engines that possess features worthy of the most careful consideration by all interested in this class of prime movers.

In designing its line of engines, the company has kept in view the importance of a proper degree and distribution of strength and weight, simplicity of arrangement and a due regard for symmetry of form. Smooth running and a long life to the wearing parts were features that also received very careful attention in the design of these engines. All bearing surfaces are large and carefully fitted, and all parts of the machine are made to gauge and are interchangeable for all engines of a given size. Before leaving the works each engine is operated for several consecutive hours at full load, tests being made under all working conditions.

Since the governor and valve constitute the vital parts of an automatic engine, the proper design and construction of these parts are necessarily of the utmost importance, in order to secure regulation and economy. The governor of the "Economic" engine consists of but four moving parts and two springs, and is unique in that a gravity balance is always maintained in the moving parts. The main governing spring consists of four small helically coiled springs wound in opposite directions, one end of which is attached directly to the eccentric plate and the other to a weighted compensating lever which is in turn controlled by a secondary spring adjustably attached to the wheel. When the governor has exerted its influence, bringing the engine to within about 1 per cent. of regulation, the compensating device acts, and by modifying or controlling the tension of the main spring a practically constant speed is maintained.

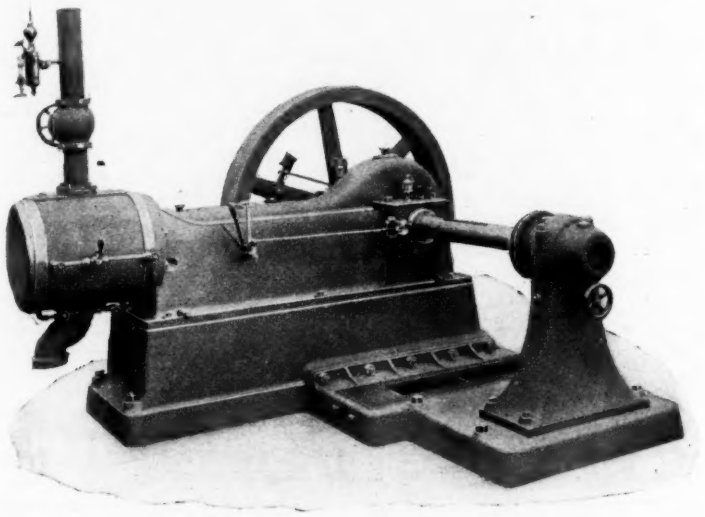
The valve is of the piston type, of a triangular form or V shape, and



Governor and Valve.

takes steam on the inside. The outer cover of the steam chest contains only the exhaust steam and affords inspection of the valve under steam. This form of valve has the same perfection of balance possessed by the circular-piston valve, admitting steam entirely around it, and at the same time affording a ready and simple means for taking up wear, so that the valves may be always kept tight. The piston is long and made hollow to afford strength and lightness. This description applies to both the centre and side-crank engines made by this company.

The centre-crank engines are especially designed for electrical and other purposes where high speed and close regulation are required. The working parts are entirely enclosed, yet easily accessible. The engines are compact, requiring little floor space, and have the strength of the material distributed in straight lines with the direction of the strains, thus combining strength with neatness and simplicity. The wearing surfaces are unusually large, thus avoiding heating under excessive loads. The entire crank case is covered by a light cast-iron cover, provided with a hinged portion to give access to the working parts. The crank shaft is in one



Engine with Bed Extended to Accommodate a Dynamo.

solid piece of forged iron or steel, of ample size to prevent springing under the most severe conditions, and the main bearings are adjustable in both ways in the direction of the wear. The system of lubrication employed is entirely satisfactory, and leaves nothing more to be desired in this direction.

The side-crank engines are set on a Tangye bed, which is designed to most effectually resist the strains and absorb the vibrations incident to hard work. The main bearing is very large and unusually strong, having an angle cap which is easily and quickly removed. The crank is very heavy, and cast of strong close iron and balanced to resist the reciprocating parts. The crank pin is made from forged steel, and the connecting rod is made of the same material and finely finished.

The tandem-compound engines possess all the features of excellence of design and construction embodied in the simple engines. They are mounted either on side or centre-crank frames and the construction throughout is the same. The low-pressure cylinder is placed next to the frame, and the high-pressure cylinder is attached to it by a distance piece of such design as to permit of the removal of both pistons without detaching the high-pressure cylinder. The company makes a specialty of this class of engines for street railway and other electrical work, and guarantees the closest regulation and the highest economy obtainable.

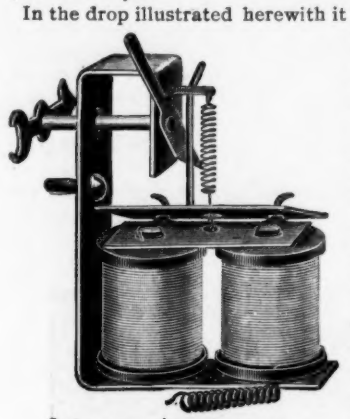
Every care has been taken in the design and construction of these engines in every detail, to the extent that the company feels warranted in making the claim that its engines may be classed among the best that the market affords.

The Eastern representative of the J. B. Allfree Manufacturing Company is the firm of H. M. Seiple & Co., Philadelphia.

A Reliable Annunciator.

Nearly everyone who has had occasion to install or repair annunciators must have seen illustrations of the disadvantages found in the different styles now in use, arising in most cases from the fact that some force (usually gravity) is depended upon to operate the indicator, thus necessitating unbalanced movable parts which in turn enable false indications to be produced or existing indications to be destroyed by a sudden mechanical shock or jar.

In the drop illustrated herewith it is believed that many such faults are overcome, owing in part to the fact that the indicator is directly moved by the armature, and is spring locked in both its indicating and normal positions, thus enabling the use of unbalanced parts to be dispensed with, preventing any jar or change in position from interfering with successful operation, and producing a positive action even when the electrical impulse is of very short duration.



IMPROVED ANNUNCIATOR.

Trouble heretofore experienced on account of the armature sticking to its magnet will never exist where this drop is used, as the action of returning the indicator to its normal position forces the armature a sufficient distance from the magnets.

By an ingenious arrangement no retractile spring is required for the armature, and the energy absorbed by the locking spring when the indicator starts is subsequently applied to complete its rotation, thus enabling the drop to operate successfully on a minimum amount of battery.

This desirable annunciator is being manufactured by the Star Electric Company, of Binghamton, N. Y., which enjoys an excellent reputation for the character and class of its goods.

American Electric Elevators on the Central London Railway.

Some details regarding the elevator equipment for the new Central London Railway, the contract for which was recently awarded to the Sprague Electric Elevator Company, New York City, may be of interest. As has already been noted in THE ELECTRICAL WORLD this contract is the largest ever taken for this class of machinery, and will include 40 machines, probably of the duplex interlocking tandem worm gear drum winding type. The winding drum is to be operated by duplex motors one geared to each end of the drum shaft. Control of the motors will be effected by means of the well-known Sprague pilot motor devices. The elevators will be distributed over 6 miles of road which is now being constructed on the twin-tunnel deep level plan. The 25 vertical shafts in which these elevators will operate are circular in cross section, and great difficulty was experienced, owing to the shape, in order to place the required number of machines in each. Five of these shafts are 30 feet in diameter and will contain three elevators each, 14 are 23 feet in diameter, and will contain two each, five are 20 feet in diameter, each equipped with one, and one shaft 18 feet in diameter is also equipped with one elevator. The minimum rise in these shafts is 41 feet, the maximum 91 1-2 feet, and the average 67 feet.

The car area will be from 140 to 260 square feet. The cars will be operated at an average speed of 175 feet and each will have a capacity of about 15,000 pounds, or 100 passengers. Empty the cars will weigh about seven tons and loaded about fifteen. The amount of material required will aggregate in weight about 2100 tons. About half of this, the machines proper, will be sent from the Sprague shops, the rest being supplied in England. Among the materials required are 130,000 feet of steel rope, 24,000 feet of steel rail, nearly 400 sheaves, varying in diameter from 42 to 76 inches, and about 160 tons of overhead beams, and 650 tons of counterweights. It is expected to have the first equipment in operation in about four months and the entire installation in about sixteen.

A New Adjustable Hanger.

We illustrate below a new form of adjustable hanger, aptly called the "Two Balls" hanger, manufactured by Mr. M. I. Vought, La Crosse, Wis. As the name implies, the simple contrivance consists of two balls which will work on any size lamp cord, and so arranged as to be attached to any device for tapping electric current. The adjuster can be best used when connected to an extension plug. In this form it is favored for residences or offices where ceiling lights are installed, which are too high to give satisfactory light. When not in use the hanger may be swung out of the way or else removed entirely. When combined with the "Handy" side swing attachment, likewise adjustable, a most complete outfit is obtained. The combinations are said to be giving entire satisfaction wherever used, and have never been removed after being given a trial.

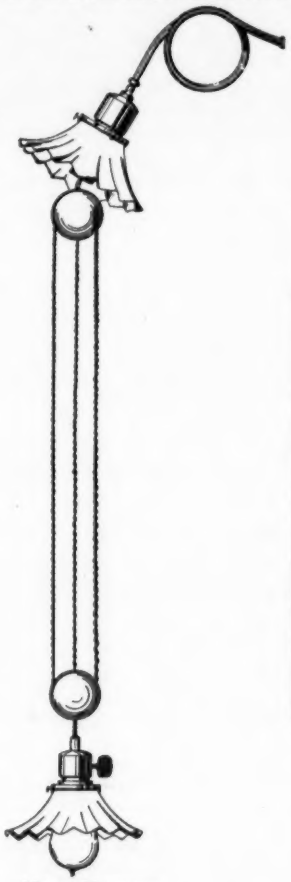
The same manufacturer is also putting on the market a series incandescent outfit for street lighting on high potential systems in which can be used lamps of any desired base or make.

The Power Plant at Ogden, Utah.

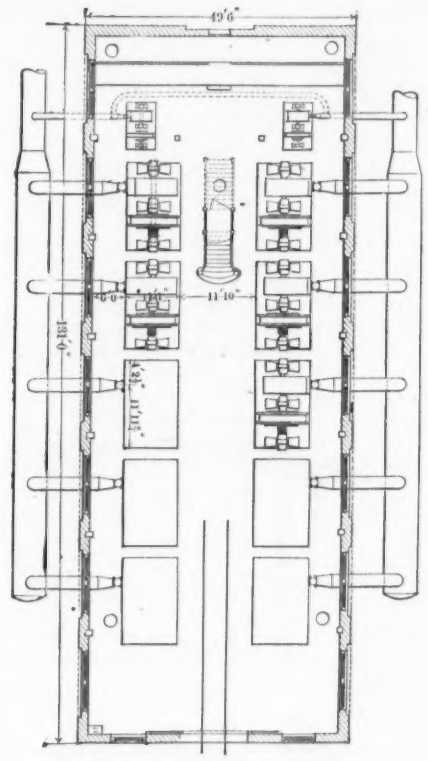
In the cañon of the Ogden River, near the city of Ogden, the latest and most important hydraulic power plant of that State, and one of the largest works of the kind yet undertaken in this country, has been carried out during the past year by the Pioneer Electric Power Company, of Utah.

The plans of the Pioneer Electric Power Company contemplate the utilization of the waters of the entire Ogden River watershed above the mouth of the cañon for the development of power as well as for irrigation. The central features of the plant are: A large storage reservoir and a masonry dam at the upper end of the cañon; a pipe conduit 6 feet in diameter, a power house with water wheels and electric generators, electric transmission lines and sub-stations for distributing the power to different points, and an extended system of irrigation canals. The storage reservoir will cover an area of about 2000 acres, and will have a capacity of nearly 15,000,000,000 gallons. A 9-foot tunnel excavated through the solid rock around the south abutment of the dam forms the outlet for the water of the reservoir. This contains two 72-inch valves, one controlling the supply of the main conduit, the other discharging the surplus water.

The main conduit is a pipe line 6 feet in internal diameter. Its total length is 31,600 feet, of which 27,000 feet is wooden stave pipe and 4600 feet at the lower end rivetted steel pipe. The pipe is laid along the side of the



NEW HANGER.



PLAN OF OGDEN POWER HOUSE.

cañon and follows the mountains to a point about half a mile beyond the mouth of the cañon. It is built to conform to a hydraulic grade line of 2 feet per thousand, a slope believed to correspond to the friction in the pipe.

From the end of the wooden pipe the steel conduit runs to the power house. The slope of this is quite steep and the pressure is from 50 to 200 pounds per square inch. It is 60 inches in diameter until it reachesa point 100 feet from the power house, where it divides into two branches, 54 inch in diameter, which lead to two receivers. The total efficient head from the flow line of the reservoir when it is full to the centre of the receiver is 446 feet.

All the steel pipe sections were rolled and rivetted at Ogden, in a shop built and equipped with machinery for that purpose.

The power house is built of pressed brick, with concrete and rubble footings, and cut stone trimmings. Its outside dimensions are 135 feet in length by 50 feet in width. A traveling crane of 15 tons capacity, operated by hand power, traverses the building, the track girders being carried by the steel posts. This building contains all the hydraulic and electric machinery used.

The water is delivered from the pipe conduit into two receivers, buried in the ground, one at either side of the power house. They are 5 feet in diameter, and, in their general appearance and the material used, closely resemble the regular steel pipe conduit, the thickness of the metal, however, being increased to seven-eighths of an inch in order to allow for water hammer.

The receivers are provided with five safety valves each, which discharge when the pressure exceeds 200 pounds per square inch, and an outlet gate at the bottom. From each of these receivers five 30-inch and one 10-inch intake pipes extend to the walls of the power house to connect with the water wheel nozzle pipes.

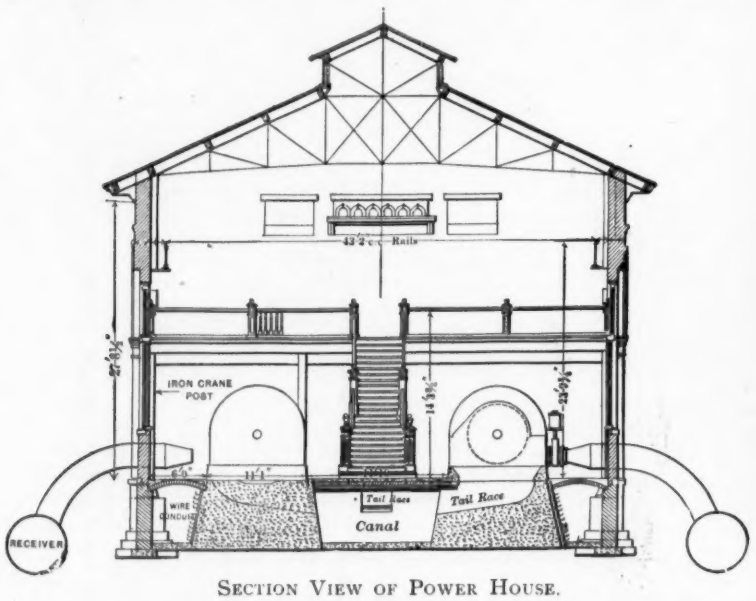
The nozzle for the water wheels has six rectangular openings or ports, 1 11-16 by 3 1-2 inches in area, of which the operator is able to close one or more, as he may desire. The levers that operate the hydraulic gate and nozzle are placed near the top of the switchboard. The set of levers for each water wheel is placed in the panel governing the generator which is driven by the wheel in question, so that the operations required in starting or stopping these machines are reduced to a minimum. The wheels are of the impulse type directly connected to the generators. The complete plant will consist of 10 units, five being already installed. The power house and receivers being built for the 10, the balance can be readily installed at any time.

The Knight water wheels are 59 inches in diameter, and have 45 bronze buckets cast in one solid piece; 14 of these will, when the nozzle parts are all open, receive the water at the same instant. These wheels are keyed to the generator shaft. Each wheel has a capacity of 1200 horse-power at 300 revolutions per minute, and each is provided with two fly wheels, about 70 inches in diameter, each weighing about two tons.

Between the two lines of machines and down through the centre of the building underneath the concrete floor is the spillway into which the wheels discharge the water, and through which the water is carried back to the river from which it is taken.

The generators used in this plant are of the General Electric Company three-phase type, with 24 poles, and at 300 revolutions per minute have an output of 750 kw at 2300 volts and a frequency of 60 cycles per second. The factory tests show that the variation in volts will be less than 5 per cent. with a constant speed, should the full non-inductive load be thrown off or on.

The exciters used on this plant are G. E. six-pole 500-volt machines, and will give 100 kw at 550 revolutions per minute. Each of these machines is ample for the entire exciting current that will be needed for the ten 750-kw alternators, and they are each direct connected to a 135-hp Knight water wheel, similar to the 1200-hp water wheels previously described. These exciter water wheels are cross-connected to each receiver, so that either exciter can be operated from either receiver.



Section View of Power House.

The generator switchboard consists of seven marble panels; five for the alternators, one for the exciter, and one for the instrument panel.

There are two sets of three-phase bus bars on the back extending the entire length of the seven panels, as well as two bus bars, also running their entire length, from which the exciting current is taken.

From the generator switchboard the current is carried to the distributing board over copper bars, of which there are two sets of three, connecting the two sets of bus bars on the generator board with the two sets of bus bars on the primary panels of the distributing boards.

The distributing board is in a gallery in the rear of the building and over the generator switchboard. Back of this distributing switchboard are nine 250-kw air blast step-up transformers, the lightning arresters and the two blowers for cooling the transformers. The distributing board is divided into two sections—the primary section and the secondary section. Each section has six panels. In the primary section four of the panels are for the low tension side of the step-up transformers, the remaining two being for the local distributing lines in the vicinity of the power plant. In the secondary section four of the panels are for the high-pressure side of the step-up transformers and two for the long-distance transmission lines.

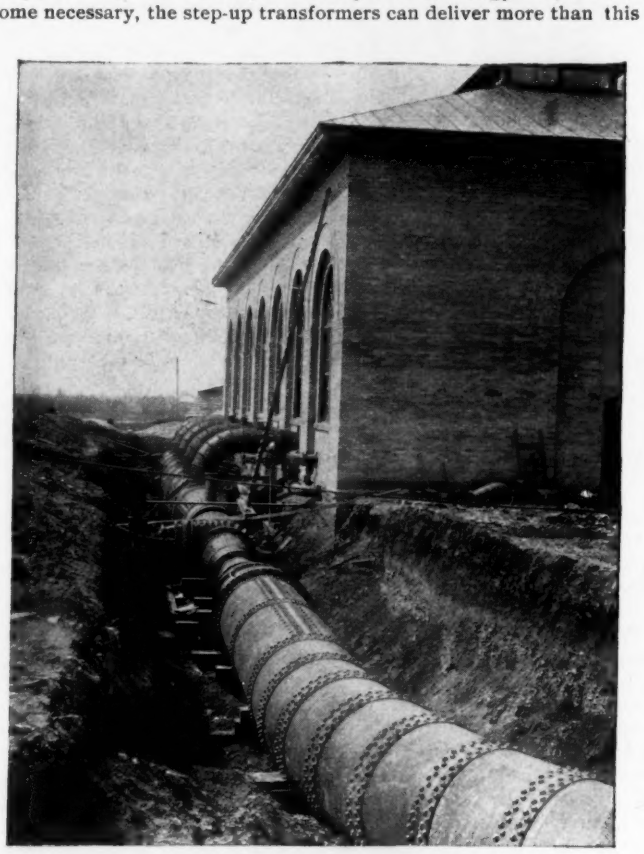
Back of the distributing switchboard and on a raised platform are placed the step-up transformers. These transformers raise the potential of the current from 2300 to 16,100 volts, at which pressure it goes onto the long distance transmission lines. The transformers are connected up in sets of three, the delta connection being used on both sides.

The transmission line is calculated to deliver about 3000 hp at the sub-station in Salt Lake City, distant about 38 miles, and consists of two circuits, making six wires of No. 1 B. & S. gauge.

The poles used on this line are of Oregon cedar, and are good, clear, straight poles, 30, 40, 50 and 70 feet long, with 9-inch and 10-inch tops. There are two cross-arms on each pole for the wires; two wires are on the top arm 4 feet apart, and four wires on the bottom arm each 2 feet apart, a circuit being on each side of the pole.

The current is fed into the transmission line at the power plant at 16,100 volts and delivered to the step-down transformers at 13,800 volts. This will give an energy loss of about 10 per cent. in the line, and a potential loss of about 14 per cent. The sub-station step-down transformers deliver this current to the local distributing lines again at 2300 volts. There are at present nine 250-kw step-down transformers at the sub-station connected by the step-up transformers, and the switchboard in the sub-station is similar in every respect to the distributing board in the power-plant gallery.

While the transmission lines are at present capable of delivering 3000 horse power at the sub-station, with a 10 per cent. energy loss, if it should become necessary, the step-up transformers can deliver more than this by changing three wires on their high pressure side and delivering the current into the transmission lines at 27,000 volts. Thus the line capacity would be more than doubled.



Exterior of Power House.

The present installation of the power plant is capable of delivering 3750 kw to its lines, but ample provision has been made to increase this amount to 7500 kw by installing five more 750-kw machines, as new industries or manufactures spring up as the result of the advantages offered to them in Ogden and Salt Lake City.

The current will be used to drive factories, running electric railways from Ogden to Salt Lake City, to the lake, to the springs and to light the towns and cities in the north of the State. The surplus water in the storage reservoir will be utilized to irrigate large tracts of land in the vicinity.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, July 12, 1897.

ELECTRICAL STOCKS.—Weakness seems to have been the characteristic feature in electrical stocks during the past week, and in every case of change of quotation a decline is recorded. The losses, however, were not great in any one instance. The Edison stocks, of New York and Brooklyn, are both about 2 points lower than at the close of the week previous, and General Electric is ¼ point lower. The sales of the latter stock during the week were 1725. Electric Storage Battery dropped a fraction, both in common and preferred issues.

TELEGRAPH AND TELEPHONE.—There is nothing particularly noteworthy in this list of stocks, the changes in most cases being merely fractional. There does not seem to have been any particular activity in any stock. American Bell Telephone closed the week with a loss of 2 points, as compared with the last quotations; the other telephones are about steady. Commercial Cable shows an advance of 7 points, while Western Union receded ¼ point. The sales of the latter stock for the week amounted to only 3193 shares.

ELECTRIC TRACTIONS.—The market for street railway securities was absolutely without feature during the week, with the exception of the strength shown by some of the Brooklyn securities. The revived rumors of probable consolidation of various surface and elevated roads in that city seem to have had slight effect on the stocks. The sales of Brooklyn Rapid Transit during the week aggregate 17,097 shares, and the closing price shows a net loss of 1¼ points. The rest of the list was practically steady, with very slight changes in a few cases.

EARNINGS.—The Edison Electric Illuminating Company of New York reports gross earnings for June of $172,060, an increase of $13,793, as compared with the same month last year, and net $63,205, an increase of $5793. For the six months ending June 30, the gross earnings were $1,228,766, an increase of $122,862, as compared with the corresponding period of last year, and net $571,714, an increase of $87,182.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Chicago Edison Company	100	110	..
Edison Electric Ill., New York	100	118½	116
Edison Electric Ill., Brooklyn	100	105	108½
Edison Electric Ill., Boston	100	147	148
Edison Electric Ill , Philadelphia	100	..	..
Edison Ore Milling	100	7½	10
Electric Storage Co., Philadelphia	100	19¾	20¼
Electric Storage, pref	100	21	22
General Electric	100	33¼	33¾
General Electric, pref.	100	..	77
Westinghouse Consolidated, com	50	21	23
Westinghouse Consolidated, pref.	50	50	51
BONDS.			
Edison Electric Ill., New York, con. 5s	105	112	..
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	..	99½
TELEGRAPH AND TELEPHONE.			
American Bell Telephone	100	228	228½
American District Telegraph	100	..	35
American Telegraph and Cable	100	91	93
Central and South American Telegraph	100	124	127
Commercial Cables	100	167	..
Erie Telephone	100	65	65½
New England Telephone	100	104½	105½
Postal Telegraph Cable	100	99	101
Western Union Telegraph	100	84	84¼
ELECTRIC TRACTION STOCKS.			
Baltimore Traction	25	18⅜	18⅝
Brooklyn Rapid Transit	..	29¼	29½
Brooklyn Traction	100	..	14
Brooklyn Traction pref	100	46	48
Buffalo Street Railway	100	69	70
Cleveland Electric Railway	100	..	..
Columbus Street Railway	100	40	43
Hestonville	100	49½	50¾
Hestonville, pref	..	..	62½
New Orleans Traction	100	6	8
New Orleans Traction, pref	100	28	30
North Shore Traction	100	20	23
North Shore Traction, pref	100	80	82
Rochester Street Railway	..	10	13
Steinway Railway	..	45	50
Union Railway (Huckleberry)	..	..	103
Union Traction, rcts $10 pd	..	12¾	13
West End, Boston	100	89¼	..
West End, Boston, pref	100	91¼	92
Worcester Traction	100	14	16
Worcester Traction, pref	100	90½	94
BONDS.			
Brooklyn Rapid Transit 5s, 1945	100	86¼	..
*Buffalo Street Railway 1st con. 5s	100	106½	108½
Cleveland Electric Railway 1st mtge., 5s	100	103	105
*Columbus Street Railway 1st 5s	100	94	96
Rochester Street Railway 1st 5s	100	..	100
Union Railway (Huckleberry) 1st mtge. 5s	..	105	107½
*Westchester Electric 1st mtge. 5s	100	100	103

*With accrued interest.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, July 15, 1897.

OFF FOR ENGLAND.—Mr. H. Barringer Cox, of the Cox Thermo-Electric Company, expects to sail for England, on Saturday, July 17, on the steamer "Campania." Mr. Cox will remain in England six weeks or more, and expects to return to America about September 1 next.

WELCOME VISITORS.—Among the prominent callers at the office of THE ELECTRICAL WORLD during the week were the following named gentlemen: Mr. F. C. Phillips, of the Elwell-Parker Electric Company, Cleveland, Ohio; Mr. Henry A. Coit, of the Missouri Telephone Manufacturing Company, St. Louis, Mo.; Mr. E. L. French, of the American Electric Telephone Company, Chicago; and Mr. A. A. Kent, of the Kent Electric Manufacturing Company, Worcester, Mass.

CONSOLIDATION OF INTERESTS.—The firm of A. K. Warren & Co., mechanical engineers, doing business at 451-455 Greenwich Street, New York, has been consolidated with the Electrical Maintenance Company, under the name of the American Electrical & Maintenance Company. Mr. A. K. Warren has been elected president, and Mr. J. R. Steers treasurer of the new company. Mr. George Stanmore, former manager of Messrs. A. K. Warren & Co., has been appointed trustee, to wind up the affairs of the old firm.

UTICA NOTES.

ELECTRICAL REPAIR WORK A SPECIALTY.—Messrs. Johnson & Morton, 26 Catharine Street, Utica, N. Y., are paying especial attention to electrical repair work, particularly the rewinding and repairing of armatures. President James F. Mann, of the Utica & Mohawk road, says that the work this firm has done for his company has been very satisfactory.

IN NEW OFFICES.—The Utica Electrical Manufacturing & Supply Company is now comfortably settled in its new and handsome offices at 219 Genesee Street, Utica, N. Y. The company's business continues to increase, and it is constantly adding to it and improving its specialties. Its new knife switch is attracting much attention. In the line of marble switchboards the company still sustains its well-earned reputation. President Brayton and Manager Ballda say the outlook for fall trade is excellent. The supply and contracting business of the company extends over a goodly portion of Northern New York State. It is putting in several isolated plants at the Thousand Islands, in addition to those in Utica and vicinity.

IN ITS NEW FACTORY.—The new factory building of the Bossert Electric Construction Company, at Capital Avenue and York Street, Utica, N. Y., is now completed, and is one of the most substantial and most conveniently arranged manufacturing establishments in Central New York. Four-inch plank floors are used throughout, and regular factory construction has been adopted. This was necessary on account of the great weight of the large drawing press used to stamp out the steel boxes which constitute one of the Bossert Company's principal specialties. The weight of this machine is no less than 119 tons, and the vibration produced by its operation may be imagined. An enameling room in which are enameled the steel boxes, and also slate for switch-

boards, is arranged for a temperature of 300°. Buffing is done in a room constructed for that purpose; nickel plating is carried on in a special room; indeed, all the work on the Bossert specialties is done on the premises. Hot and cold water is provided throughout the building, both up stairs and down. One dynamo is used for lighting the factory and another for testing purposes. The engine is of the well-known Ames type, and is of ample power. The Bossert Company was much crowded for room in its old quarters; in its present admirable location, however, with its extensive floor space, it has excellent facilities for manufacturing.

BUFFALO AND NIAGARA FALLS NOTES.

BUFFALO, N. Y., July 12, 1897.

ELECTRIC ROAD COMPLETED.—The electric road between Bradford and Olean is at last completed. Cars started running for the first time between the two cities on July 12.

THE CANADIAN POWER COMPANY BEGINS CONSTRUCTION WORK.—Saturday last a force of men broke ground for the Canadian Power Company's canal at Chippewa, Ont. The canal will be 15 feet deep, and it is said that the first section of it built will develop 40,000 horse-power.

ELECTED PRESIDENT.—The Canandaigua Electric Light & Railroad Company has elected Mr. Thomas H. Feary, of Buffalo, president. Mr. Feary was instrumental in the consummation of the deal between the village stockholders and Buffalo and Warsaw capitalists for the transfer of the plant.

G. A. R. ELECTRICAL DISPLAY.—It is feared now that the much-vaunted scheme for an electrical display in Buffalo during G. A. R. week will fall through. The local committee has been doing all that is possible to raise money to carry out the project, but so far it has not succeeded in raising enough to pay for an illumination that would be a credit to the city.

PREPARING THE WAY FOR MORE POWER.—The Commissioners of Public Works have approved of the new route proposed for the electrical conduits and supply wires in this city of the Cataract Power & Conduit Company. They also approved of the company's bond of $250,000, filed last week in this city, and asked the Board of Aldermen to approve of both the route and the bond.

NEW ELECTRIC LIGHT POLES.—The Buffalo General Electric Company has been replacing its electric light poles on the main streets of this city by new and highly ornamental ones. They are of wrought iron, made in sections. Each pole is 25 feet long, and weight about 1250 pounds. Near the top is an ornamental cross-arm, from which are suspended two lights, so placed that the arcs are 18 feet from the ground.

TO PRODUCE DIAMONDS.—Either Buffalo or Niagara Falls is to have the first diamond manufactory in the world. Mr. J. B. Richardson, who claims to be from New York, has been in this city for some time, inquiring into the cost of electricity here and at the Falls, and the price of land for the site of a factory intended to turn out diamonds artificially produced from pure carbon. Mr. Richardson maintains an air of the greatest secrecy, and refuses to divulge the names of the people whom he is supposed to represent. He declares that he has plenty of capital behind him, however, and that the process of manufacture which will be used has been received favorably in Washington, and that the exclusive right to use it will soon be granted by the Patent Office. He lays more stress on the value of the prospective manufactured diamonds as abrasives than as jewels, and declares that their production will revolutionize many industries where abrasives are used.

ERIE, PA., NOTES.

IMPROVING ITS ENGINE.—The Ball Engine Company, of Erie, Pa., has recently considerably modified and simplified the governor for its engine. The new governor works most satisfactorily, and all Ball engines will hereafter be provided with the device.

TO MANUFACTURE ELECTRIC MOTORS.—The Erie City Iron Works will soon add the manufacture of motors to its other specialties. Mr. C. J. Sturgeon will have charge of the motor department. Particular attention will be paid to reversible motors.

AN EXCELLENTLY EQUIPPED FACTORY.—The Keystone Electric Company's factory at Erie, Pa., is one of the best equipped buildings of its kind in the country. The addition recently completed gives the company facilities for handling considerable business. The windows in the different buildings are large and the ceilings high. The lathes, presses, machine tools and other appliances are of the latest design, and each is operated by an independent electric motor. The company has made an important improvement in the design of its machines for elevator work, of which the regulation will hereafter be in the motor itself, obviating entirely the devices heretofore used for that purpose. Tests show that many of these motors take even less current to start than when running at full load. The bi-polar type of machine has given place to one of multi-polar design, from which excellent results are obtained. Mr. J. W. Leech, the secretary and treasurer, has been connected with the Keystone Electric Company since 1889. Mr. F. B. Downing, the vice-president, is doing good work in systematizing the factory practice and in assisting Mr. Leech in the business department. The Keystone Company has always made a specialty of reversible motors for elevator work, and its reputation is the very best.

PITTSBURG NOTES.

PITTSBURG, Pa., July 12, 1897.

NEW TROLLEY LINE BEGINS OPERATION.—Cars on the Braddock & Homestead Street Railway Company's line were placed in regular operation on July 4. This line begins at the terminus in Munhall of the Homestead & Highlands Company's tracks and extends three miles, crosing the Monongahela River into Braddock on the new bridge at Harden station. An arrangement exists between the two companies whereby cars are run through from Pittsburg and Braddock without change. The river is crossed twice on this trip, and the fare charged between Pittsburg and Braddock is ten cents.

TRANSFER COMPLETED.—The final step in the deal between the Pittsburg, Allegheny & Manchester Traction Company and the United Traction Company was taken on July 9, when the last papers were signed, and the entire property of the former company was formally transferred to the latter. Notices had been sent to the Pittsburg, Allegheny & Manchester stockholders requiring them to deposit their certificates of stock on or before July 9 with the Pittsburg Trust Company, in accordance with the terms of the agreement; 56,000 shares out of a total of 60,000 were so deposited, and the formal transfer was therefore made on that date. The remaining 4000 shares will doubtless be turned in promptly.

TOO MANY TELEPHONE POLES.—For some weeks past the Central District & Printing Telegraph Company has been busily engaged in erecting poles in the Borough of Wilkinsburg on streets that had not previously been occupied by this company. The opinion was pretty freely expressed that the erection of these poles is not demanded by the increased business of the company, and that its real object is to occupy as many streets as possible simply for the purpose of preventing a competing company from getting a foothold. At a recent meeting of the Borough Council's Committee on Corporations, it was decided to recommend the passage of a resolution ordering the immediate removal of all the recently erected poles. The grounds alleged for this action are: First, that the company failed to accept within the time specified the ordinance granting it rights of way; secondly, the company neglected to give to the Street Commissoner the notice required by law of its intention to erect the poles. At the same meeting of the committee the application of the Home Telephone Company for rights of way was acted upon favorably.

CHICAGO NOTES.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill., July 12, 1897.

PAID THEIR RESPECTS.—Among the callers at the office of THE ELECTRICAL WORLD during the past few days were the following named gentlemen: Prof. W. H. Williams, of the Montana State College, Boseman, Mont.; and Mr. Garrett A. Vallee, of Vallee Brothers & Co., Philadelphia. Professor Williams, who is in charge of the mechanical and electrical engineering department of the Montana State College, is in the city purchasing a line of heavy electrical machinery. Mr. Max A. Berg, of the Ohio Brass Company, Mansfield, Ohio, also called at THE ELECTRICAL WORLD office during the past week. He finds business in general decidedly improved.

IN A NEW POSITION.—Mr. W. H. Whiteside has accepted the position of manager of the sales department of the Gates Iron Works, Chicago. His ability as a salesman has been thoroughly demonstrated, and this, coupled with his high standing as a business man, makes him a most valuable addition to the company. His many friends wish him every success, and will leave nothing undone to throw business in his way whenever the opportunity presents itself.

ELECTRIC RAILWAY SUPPLIES.—No electrical house in the country is better known than the Central Electric Company, Chicago, Ill. This concern has for years stood high in the trade list, especially in the electric railway and supply lines, and it is never caught napping in any of its departments. It keeps to the front, always—that is the motto of the company—and it handles nothing but what is conceded to be the best. As evidence of this is a letter received by the company recently, ordering additionally 300 "Central" hangers. These hangers, the writer of the letter states, are so satisfactory that he will accept nothing that is not as good. The Central Electric Company, it may be stated in this connection, has lately designed some new railway specialties, of which it is selling large quantities. Among these are trolley wire and feed-wire splicers, of both the mechanical and solder types. The company carries a complete line of figure 8 materials and is prepared to make prompt shipments from stock.

ST. LOUIS NOTES.

ST. LOUIS, MO., July 12, 1897.

WANT TO CHANGE TO ELECTRICITY.—A bill was introduced in the City Council last Friday authorizing the use of electricity on the Broadway line, and permitting it to extend its track in a southwesterly direction to a point near the city limits.

PERMISSION GRANTED.—The Council Railroad Committee decided last week that the Suburban road can build its down-town loop, but that it must use Fourth street, as Third Street was too narrow. It must also pay the city $7500 for the franchise. It is not known whether the road will accept the conditions or not.

LITIGATION HAS ENDED.—Litigation between the Bell Telephone Company and the St. Louis Underground Service Company is practically ended, as the Bell Company finally succeeded in reopening its conduits, and passing around the Sutter manhole at Fourth and Olive Streets without damaging it. The damaged manhole was repaired at the expense of the Bell Telephone Company.

OBJECT TO THE SALE.—Objections to the confirmation of the sale of the Fourth Street & Arsenal Railroad have been filed in court. The objections set forth that the purchaser deterred persons from bidding by proclaiming that the sale was irregular and would be attacked. The decree of sale is said to be defective, and that the sale resulted in a sacrifice of the property. An order is asked to annul the sale and resell the property.

EDISON REORGANIZATION.—The bondholders of the Edison Illuminating Company will go into court this week and begin foreclosure proceedings. The papers in the suit are being drawn up, and will ask for a sale of all the property included in the deed of trust. As there is no opposition to the plan, it is expected that the foreclosure sale will take place within a few weeks. The assets of the old company will be bought in by the Reorganization Committee.

PACIFIC COAST NOTES.

SAN FRANCISCO, Cal., July 2, 1897.

SOMERSVILLE, CAL.—It is stated that an electric light plant will soon be installed here.

MR. ANDREW J. COFFEE, for several years superintendent of the fire and police telegraph system of Portland, Ore., is again located in San Francisco. He is representing the Willard Electric & Battery Company, of Cleveland, Ohio, and the United States Fire & Police Telegraph Company, of Boston, Mass.

ORDERS FOR ELECTRIC MINING LOCOMOTIVES.—The General Electric Company has sold, through its Pacific Coast District Agency, two special electric mining locomotives to the Mountain Copper Company, at Keswick. Also a 25-hp mining locomotive and material for a 2-mile electric transmission for use at the Hidden Treasure Mines.

PROPOSED LARGE STORAGE BATTERY INSTALLATION.—The San Francisco Gas & Electric Company has decided to install a large number of storage batteries as an adjunct of its extensive underground three-wire system of distribution. The Electric Storage Battery Company, of Philadelphia, will supply the cells, which will be fitted with the Manchester plate. The initial order, which is the largest ever given for storage batteries on the Coast, calls for 1760 amperes on a side, making the total capacity about 3500 amperes, at a pressure of 110 volts. The cells are to be installed in the Jessie Street station by November 1, next. The present generator capacity of the station is about 17,000 amperes.

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON, June 30, 1897.

BRITISH SLOT-WOUND DYNAMOS AND MOTORS.—Messrs. Easton, Anderson & Goolden, of Erith, are now making slot-wound armatures for their continuous current dynamos and motors, in place of the surface-wound armatures which they formerly employed. Some eighteen months ago this firm constructed the first machine of the series they now make, and the results obtained were so good as to justify the general adoption of this type. I have recently had an opportunity to go over the works of this firm and to examine the stages of manufacture of these machines. The dynamos are made in sizes from ¾ kilowatt to 300 kilowatts. The sizes from ¾ kilowatt to 110 kilowatts are provided with 4 poles, up to 200 kilowatts 6 poles and up to 300 kilowatts 8 poles. For the smaller machines, up to 30 kilowatts, cast iron is used throughout, but between 30 and 110 kilowatts the frames and beds only are of cast iron, the poles being of cast steel, and for the larger sizes the machines are made either wholly of cast steel, or with cast iron frames and beds and steel poles, acording as may be desired. The armatures are drum wound with copper strip or round copper rod, the slots being deep and narrow, and the air gaps comparatively small. The machines are constructed for a temperature rise of about 70 degrees or 80 degrees in the armature and 60 degrees or 70 degrees in the field coils, but in the very large machines a still lower temperature rise is found to take place. Notwithstanding the small air gap there is practically no heating of the poles and no sparking at the commutator. Even when copper gauze brushes are used the variation of load between no load and full load is from 5 degrees to 2 degrees, and proportionately less for carbon brushes. All these machines have been designed by Mr. V. A. Fynn, the electrical engineer to Messrs. Easton, Anderson & Goolden. One of the 50-kw machines was lately exhibited at the Newcastle exhibition, and was subjected to tests which resulted as follows: The machine developed 230 volts and 220 amperes at 750 revolutions per minute, the field being shunt wound. The weight of the machine was 128 pounds per kilowatt, exclusive of slide rails, but including the pulley. The air gap of this machine was three-sixteenths inch on each pole. After six hours running at full load the temperature rose to 65 degrees in the field coils and to 70 degrees in the armature. The lead necessary for sparkless collection was 4 degrees with copper brushes. The magnetizing current represented 2 per cent. of the full load, and the commercial efficiency of the machine was 94½ per cent. Keeping the resistance of the exciting circuit constant and the speed also constant, the variation of volts from full load to no load was from 230 to 245 volts. While at the Erith Ironworks I also saw in process of manufacture some electric motors provided with this slot-wound armatures, which were being built for working coal cutters in collieries. These motors were carefully enclosed and ironclad, and in one instance a motor which had been running for some considerable time with a surface-wound armature was being equipped with a new armature with slot winding.

General News.

NEW INCORPORATIONS.

NORTHAMPTON ELECTRIC RAILWAY COMPANY, Easton, Pa., has been granted a charter. The company is capitalized at $300,000.

THE W. E. & W. DREW ELECTRIC LIGHT COMPANY has been incorporated at Colebrook, N. Y., with a capital stock of $17,000.

THE HACKENSACK & PASSAIC RAILROAD COMPANY, Hackensack, N. J., has been formed by W. P. Standish, J. H. Hertzberger and Mr. Smith.

THE BROOKFIELD ELECTRIC LIGHT COMPANY, Brookfield, Mo., has been organized by J. F. Huffaker, R. J. Wheeler and M. Y. Rusk, with a capital stock of $30,000.

THE WHITEFISH BAY RAILROAD COMPANY, Whitefish Bay, Wis., has been incorporated with a capital stock of $1000. The incorporators are C. R. Gether and J. J. Perkins.

THE NEOSHO ELECTRIC LIGHT COMPANY, Neosho, Mo., has been formed with a capital stock of $6000. The directors are Truston F. Ratliff, John B. Murray and John C. Meyer.

THE INTERSTATE TELEPHONE & ELECTRIC COMPANY has been incorporated at Dubuque, Ia., with a capital stock of $100,000. The incorporators are F. F. Sapp, E. T. Keim and R. W. Stewart.

THE PEMBROKE ELECTRIC RAILWAY COMPANY, Harrisburg, Pa., has been incorporated with a capital stock of $300,000. The directors are Edward Thompson, Henry C. Ferry and E. D. Wadsworth.

THE LOCKPORT ACETYLENE COMPANY, Lockport, Ill., has been incorporated for the purpose of furnishing light. The directors are Frank Sloan, John Ward and Edmund I. Sloan. Capital stock, $10,000.

THE INTERNATIONAL ELECTRIC PURIFYING COMPANY has been incorporated at St. Louis, Mo., with a capital stock of $10,000. Those interested are Dexter Reynolds, William Heibling and E. H. Johnson.

THE AMERICAN INCANDESCENT BURNER COMPANY, of New York City, N. Y., has been formed by Joseph H. Meyers, Elmer E. Tappan and Jonathan Berlinicke, of New York City. Capital stock, $2000.

JALAPA RAILROAD & POWER COMPANY has been organized and articles of incorporation filed with the Secretary of State at Trenton, N. J. The capital stock is $250,000, and the purpose of the company is to construct and operate a railroad in Mexico. The incorporators are Homer B. Parson and Elliott M. West, of Brooklyn; and J. Milton Ferry, of Bayonne, N. J.

THE NEWBURGH ELECTRIC RAILWAY COMPANY, Newburgh, N. Y., has been incorporated with a capital stock of $150,000. The formation of this company is the result of the consolidation of the Waldon & Orange Lake and the Newburgh & Orange Lake Railroad Companies with the present Newburgh Electric Railway Company. The incorporators are Benjamin Norton, of New York City; Silas B. Dutcher, William H. Pouch, Alfred J. Pouch, Alden S. Swan, William M. Tobias and S. S. Whitehouse, of Brooklyn; and Charles N. Finch, of Summit, N. J.

THE TELEGRAPH AND TELEPHONE.

VAN ALSTYNE, TEX.—The Southern Telephone Company is putting in a telephone exchange at this place.

BENTON HARBOR, MICH.—Coloma and Benton Harbor are to be connected with an independent telephone line.

NEW ALBANY, IND.—The line of the Home Telephone Company has been extended to Greenville, 10 miles north of this city.

BATESVILLE, ARK.—A very disastrous fire occurred in this city on July 4, which destroyed twelve buildings, including the telephone exchange.

HANAMO, MO.—The Hanamo Telephone Company is extending its line to Skidmore, by way of several intervening towns, and contemplates going further.

FRIENDSHIP, WIS.—A telephone line has been completed between Friendship and Kilbourn, with stations at Plainville, Ohio, Point Bluff, White Creek and Easton.

KIRKWOOD, ILL.—A franchise has been granted to the Henderson County Telephone Company to erect poles and maintain a telephone system in the village of Kirkwood.

STILLWATER, MINN.—The new telephone line from Stillwater to Hudson has been completed, thus enabling this city to connect with St. Croix and Pierce County circuits.

NASHVILLE, TENN.—The Southern Telephone Company has been granted the right of way into Nashville. The new company claims to already have 1500 subscribers in this place.

TOLEDO, OHIO.—The Cole County Telephone Company has commenced building its lines throughout this section and will eventually reach Toledo. The lines will be metallic circuits.

NEWARK, OHIO.—The Newark Telephone Company now has connection with Utica, Vanatta and St. Louisville, and new lnes to Homer, Fredonia, Chatham and Highwater will soon be in operation.

GALESBURG, ILL.—A telephone company has begun the construction of a line from here to Quincy, where there is no line at the present time. The wire will be copper, and long-distance telephones will be supplied.

COLORADO SPRINGS, COL.—The Colorado Telephone Company has purchased a piece of ground in this city on which it will erect a building for its own use. The construction of the new exchange will be commenced at once, and the building will cost at least $10,000.

JOLIET, ILL.—The time limit given by the City Council to the Chicago Telephone Company to remove its poles has expired. Three local capitalists have petitioned the Council for a franchise and the interests of the local concern and those of the Chicago company are likely to precipitate a fight for a franchise.

DAVENPORT, IOWA.—The Iowa Telephone Company is stringing six new copper toll lines to Dubuque. Another circuit will be built from Clinton to Cedar Rapids. The company is pushing work on its metallic circuit from Davenport to Burlington and Keokuk, having two gangs in the field at this time.

ST. PAUL, MINN.—The Mississippi Valley Telephone Company is seeking a franchise to do business in this city. The period of the proposed franchise is ten years, the city reserving the right to purchase the plant at the end of that time. The rates to subscribers are to be $48 a year for business and $30 for residence telephones within a radius of two miles from the City Hall. Telephones are to be furnished to the Police Department and maintained at $3.65 a month and to the Fire Department for $2.50 a month. In consideration of the franchise the company is to pay to the city 2 per cent. of the gross earnings on all under 1600 telephones in operation, and 5 per cent. of the gross earnings on all over that number.

Electric Light and Power.

WOONSOCKET, R. I.—The town of Millis has voted an appropriation for the purpose of operating an electric light plant.

ATTALLA, ALA.—The water works and electric light plant of this place has been leased from the city for five years by the Attalla Foundry & Machine Company.

BAY ST. LOUIS, MISS.—Plans are being prepared by Nisbet Wingfield, of Atlanta, Ga., for the proposed electric light and water plant to be built at Bay St. Louis.

OLNEY, ILL.—The contract for lighting the streets of Olney was awarded to Edward S. Hughes, of Cincinnati, Ohio, at $2480 a year. The contract is for ten years.

LANCASTER, PA.—John E. Graybill has been awarded a contract for an electric light plant at Kinzer's; also a contract for remodeling the electric light plant at Shippensburg.

HARTFORD, CONN.—The Central Railway & Electric Company agrees to furnish the city with not less than 126 street lights, at $90 per year for each light, and additional lights at the same rate.

WICHITA, KAN.—At a meeting of the Council, Dr. Minick, Chairman of the Lighting Committee, reported in favor of the city erecting an electric light plant at a cost not to exceed $40,000.

MEDINA, N. Y.—The electric light and gas plant at this place, which was incumbered with a mortgage of $17,500 about to become due, has been sold to a stock company, some of whom are mortgagees.

HAMBURG, N. Y.—The fire which broke out at the Hamburg Electric Works last week destroyed much valuable machinery, and the operation of the electric street cars was interfered with in consequence.

MADISON, WIS.—The State Board of Control has awarded the contract for the putting in of an electric lighting plant at the Northern Hospital, at Oshkosh, to the Western Electric Company, of Chicago. The contract price is $14,500.

HOLLAND, MICH.—The Holland & Lake Michigan Electric Railway Company will begin work on the construction of a power house which will furnish electric lights to the cottages along Black Lake and Central Park, Harrington's Landing.

VICTORIA, TEX.—The electric light plant was sold on July 2 to H. H. Rathbone and L. L. Stephenson. The new management will take charge immediately, a new corporation having been formed. The price paid for the plant was $9500.

PAXTON, ILL.—An appropriation of $3000 has been made for the purchase of an electric light plant to be controlled by the city. A motion to accept the proposition of the Paxton Electric Company to continue to furnish lights at a specified rate was voted down.

COLUMBUS, GA.—A company has been formed here to develop the water power of the Chattahoochee. The company has secured the Rock Island mill site, two miles above the city. A large plant will be erected on the site, and electrical power will be developed.

MT. PLEASANT, IA.—The contract for the erection of a new municipal electric light plant has been awarded to James Brown, of Burlington, for $1425. The contract calls for the completion of the work in thirty days. The building will be of brick, 32 x 76 feet, and one and one-half stories high.

KANSAS CITY, MO.—The Consolidated Electric Light & Power Company gave a mortgage for $125,000, on July 1, on its entire property, including plant, electric wires, posts, etc., to the Rhode Island Hospital Trust Company, of Rhode Island. It is stated that the mortgage was given for the purpose of taking up the old loan and renewing it, that it was to secure an extension of the time payment at a lower rate of interest.

BALTIMORE, MD.—On July 7, all the property and franchises of the United States Electric Power & Lighting Company were sold at public auction. The property was bid in by Mr. John B. L. Haynes for $55,000. The sale included the ground and improvements, where the company's plant is located, together with the dynamos and machinery for about 480 arc lamps. The company has erected 194 poles and operated 55 miles of wire.

The Electric Railway.

FREDERICK, MD.—The Frederick & Middletown Electric Railway Company will build a power house on Catoctin Mountain.

HAGERSTOWN, MD.—It is reported that Baltimore capitalists will construct an electric road to connect the various resorts around Penmar.

BRADDOCK, PA.—At a meeting of the Rankin Borough Council steps were taken toward declaring forfeited the franchises of the Braddock Electric Street Railway.

VINEYARD HAVEN, MASS.—An electric railway is proposed between Vineyard Haven and Edgartown, Martha's Vineyard. It will carry freight as well as passengers.

ONEONTA, N. Y.—The State Railroad Commission has granted the application of the Oneonta Street Railway Company for permission to change its motive power from horses to electricity. The commission has also approved the increase of the capital stock of the Olean Street Railway Company from $16,000 to $300,000.

KALAMAZOO, MICH.—The Eastern capitalists who recently obtained control of the Kalamazoo street railway interests, have, it is stated, purchased the Battle Creek Railway.

STREATOR, ILL.—John B. Whelan, of Syracuse, is promoter of an enterprise to build an electric road from this place to Lake Geneva, Wis. A survey of the route is being made.

EASTON, PA.—The Easton, Palmer & Bethlehem Electric Railway Company has secured the right of way from this city to Bethlehem, and the new trolley road is an assured fact.

WHITESTONE, L. I., N. Y.—The citizens of Whitestone have decided to unite in an effort to secure an extension to their village of the Steinway Electric Railway, which at present terminates at College Point.

BRISTOL, PA.—The Bristol Trolley Company is now assured a complete through route from Bristol to Philadelphia. Heretofore there has been a break in its line at Croyden station of about 100 feet.

YOUNGSTOWN, PA.—The Youngstown Valley Railroad Company has secured franchises from the boroughs of Christy Park and Versailles. They will give that line a complete connection between West Newton and McKeesport.

MILWAUKEE, WIS.—The Milwaukee Electric Railway & Light Company will soon commence work on the extension of tracks to Waukesha from North Greenfield. It is expected that cars will be running this fall. John J. Beggs is the general superintendent.

WHITE PLAINS, N. Y.—The New York, Elmsford & White Plains Railway Company has, it is stated, sold out to a syndicate of Philadelphia capitalists, who, as soon as the details of the purchase are perfected, will proceed to complete all the plans of the local company.

AUGUSTA, ME.—A petition has been received by the Maine Railroad Commissioners for the approval of articles of association for a railroad to be known as the Aroostook Northern Railroad, for the purpose of constructing a line from Bangor and Aroostook to the town of Limestone.

JERSEY CITY, N. J.—It is stated that the controlling interest in the Northern Railroad of New Jersey, which runs from Bergen Junction to Nyack, has been sold to a syndicate, which is said to be in the interest of the Consolidated Traction Company, of New Jersey. It is thought that electricity will be substituted for steam as a motive power.

Personal Note.

THE ANNOUNCEMENT is made of the marriage on Saturday, July 3, of Mr. Kemster B. Miller, the electrical engineer of the Western Telephone Construction Company, to Miss Antha Knowlton, of Philadelphia, at the residence of the bride's mother, in Chicago. Mr. and Mrs. Miller left immediately for a month's trip to California.

Trade and Industrial Notes.

FROM NEW JERSEY TO PENNSYLVANIA.—The office and factory of the Pennsylvania Microphone Company has been moved from Camden to the company's new and larger factory at 411 Cherry Street, Philadelphia, Pa., in order to accommodate its increasing business.

HONORED IN ITS OWN STATE.—The Sterling Varnish Company, Pittsburg, Pa., recently ordered a 75-hp Ball automatic engine for electrical purposes from the Ball Engine Company, Erie, Pa. When first-class engines are sought after the Ball Company generally gets its share of such business.

THE STOW MANUFACTURING COMPANY, of Binghamton, N. Y., is working full time filling orders for its well-known Stow Flexible Shaft and Iron-Clad Electric motor. In railroad shops, in boiler shops, in fact, in any work where drilling, tapping, reaming or emery grinding is done, "the Stow" has been found to be indispensable.

NO WONDER BUSINESS IS BRISK.—Mr. Henry A. Coit, sales manager of the Missouri Telephone Manufacturing Company, St. Louis, Mo., recently returned from a trip, which is the supposed reason for the marked improvement in the company's business. The company recently closed several good contracts in Kansas, and it has enough work on hand to keep its factory busy for some weeks to come.

HONEST GOODS AND HONEST PRICES.—The severe competition in the manufacture of electric bells has resulted in lowering the grade as well as the price of the regular electric house bell. Realizing the fact that the trade demanded a better article in the line of an iron box bell, the Electric Appliance Company, Chicago, is placing on the market its Reliance iron box bell, which it claims is considerably better than anything in this line that has been placed on the market for some time. These bells cost more money to make, but are put on the market at an honest price, and to meet the demand of customers who are willing to pay a fair price for a good article.

TELEPHONE POLES.—The independent telephone movement is one of the greatest industrial facts of the present day, and everything seems to be going its way. Independent telephone companies will no doubt be interested to know that their cause is fostered by supply dealers, and not the least among these are the pole men. The Point Marion Manufacturing Company, Pittsburg, Pa., is furnishing poles to the Home Telephone Companies in Pittsburg and Erie, Pa., and Wilmington, Del., and these poles are said to be giving excellent satisfaction to the companies using the same. The Point Marion Company is prepared to fill any size order on short notice, and inducements are offered which are calculated to help along the independent telephone industry.

THE COMPRESSORS.—The Clayton Air Compressor Works, New York, have just issued catalogue No. 9, containing illustrations and descriptions of the newest features of the Clayton air compressors, which are the results of an experience covering twenty-five years. Besides explaining in detail the many types of

duplex and single compressors for air and carbonic acid gas, driven by steam, belting or gears, it describes at length many devices intended to be used in connection with this power, such as rock and air drills, riveters, straight-lift air hoists, fuel burners, etc. It also illustrates the Clayton air-lift pumping system, which is claimed to show remarkable results in raising water. Much valuable data is to be found for figuring the loss of pressure due to friction in the transmission of compressed air, and also the capacity lost by compressors operating at various altitudes above the sea level. The booklet is for gratuitous distribution, and a copy will be forwarded on application.

A WELL-KNOWN ENGINE.—American engines are going all over the world, and have won a reputation for excellence of design and finish. The Gates Iron Works, Chicago, Ill., has a reputation for excellence of work and high-grade machinery, which dates back a period of half a century. There is probably no other engine builder in the country who has better facilities than this concern, and few more extensive. Its products go to all parts of the world. The corps of engineers employed in its service is large and efficient, and its engines are not built upon the one-man idea, but include the very latest developments in this industry. Every piece of work must pass the inspection and approval of the several heads of the engineering force before the engines are put out. Among the recent sales of the Gates four-valve automatic engine are the following: One 125-hp engine, American Express Company, Chicago; one 150-hp engine, Lassag Bridge & Iron Works, Chicago; one 100-hp engine, City of Sycamore, Ill.; one 125-hp engine, Hospital for the Insane, Clarinda, Ia.; one 125-hp engine, Iowa State Penitentiary, Anamosa, Ia.; one 400-hp engine, Cedar Rapids Electric Light & Power Company, Cedar Rapids, Ia.; one 125-hp engine, City of Woodstock, Ill.; one 200-hp engine, F. J. Matthiessen, Chicago; one 125-hp engine, Iowa Institution for Feeble Minded Children, Glenwood, Ia.

LARGE CONTRACTS FOR CABLES.—The contracts for the underground work in St. Louis, Mo., for both the Bell Telephone Company of Missouri and the Kinloch Telephone Company, which were recently granted to the Standard Underground Cable Company, are believed to be the largest of the kind ever let in this country—the two orders comprising all of the underground cables in St. Louis yet contracted for, and constituting the complete equipment for both companies. Both contracts were secured in the face of the most severe competition, and the well-known excellence of the telephone cables manufactured by the Standard Underground Cable Company largely influenced the placing of the order with it, as the prices were very close. To fill these contracts there will be required more than 650,000 feet of cable, which in turn requires about 100,000,000 feet of No. 19 B & S. gauge copper wire and 2,000,000 pounds of lead. In order to meet the extraordinary demand, the manufacturing facilities of the company in the paper-covering department have recently been doubled, which places it in a position not only to handle this enormous volume of business rapidly and easily, but at the same time to fill without any delay the large and constantly increasing orders for telephone, electric light and power cables, rubber-insulated wire, etc., which are being daily entered. Considerably more than one-half of this cable will be installed by this company, which has contracted to turn over the system of the Kinloch Telephone Company, complete and ready for use.

A WELL-EQUIPPED RAILWAY STATION.—The contract for equipping the new Southern Terminal station, Boston, which was recently let to Westinghouse, Church, Kerr & Co., contains many new and interesting features, covering a very wide range of engineering, some of which have never before been used in railway practice. The power house equipment calls for ten boilers with economizers and mechanical draught, together with 1500 horse-power of Westinghouse compound engines, direct-connected to Westinghouse multipolar generators. It is intended to use salt water for condensing except where steam is utilized for heating. The arc and incandescent lighting has been laid out with special reference to station service, and the wiring includes a complete telephone system. For the accommodation of passengers and the quick handling of freight and baggage from the train sheds to the subway nineteen electric elevators are to be installed. The heating and ventilating have been carried out on a very large scale, employing both the direct and indirect methods in addition to a series of exhaust fans driven by electric motors. An extensive system of car heating has been adopted, covering over 40 acres, and special features have been introduced so that the cars may be heated in any location when detached from the engine. A novel feature is an ice-making and refrigerating plant for supplying the cars with pure ice, and also for supplying a means for cooling the drinking water and preserving restaurant supplies. Complete apparatus for switching and signaling by the Westinghouse electro-pneumatic interlocking system, covering the operation of four railroads, will be installed, to be operated from eight iron signal bridges. Among the other sections may be mentioned air-brake testing, fire protection, disposal of drainage, and frost protection of roof conductors, which latter is for keeping the conductors and gutters free from ice during the cold weather. As a whole, the Boston Southern Terminal station was designed by Mr. George B. Francis, C. E., resident engineer, and the chief engineers of the New York, New Haven & Hartford, Boston & Albany, New York & New England, and Old Colony railroads, while the president, Mr. Charles R. Clark, and the Board of Trustees have given a great deal of attention to many of the important features.

Business Notice.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 67-71 Park Place, New York City.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JULY 6, 1897.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

585,662. SWITCHBOARD FOR CENTRAL TELEPHONE STATIONS; C. E. Egan, Chicago, Ill. App. filed Dec. 2, 1895. The combination of flexible arms, having sockets mounted thereon, contact-points on each side thereof included in the circuit of the signaling apparatus.

585,663. ELECTRIC ATTACHMENT FOR MUSICAL INSTRUMENTS; W. B. Fleming, Detroit, Mich. App. filed Jan. 13, 1897. In an attachment for musical instruments, a roller, a conductor in electrical connection therewith, a shaft provided with series of discs adjacent to said roller, mounted upon said shaft, and insulated one from the other, and spring contact-arms in electrical connection with said discs.

585,676. RAILWAY DANGER SIGNALING; J. K. Kendrick, Germantown, Cal. App. filed Nov. 2, 1896. In a device for signaling railway trains, the combination with a suitable locomotive and road-bed of a pilot car mounted on suitable trucks and provided with suitable motive power and adapted to precede the locomotive at a suitable distance, a cow-catcher mounted in front of such pilot car on horizontal bars, which are arranged longitudinally in suitable bearings on such pilot car, a lever pivotally attached to the side of the pilot car and adapted to engage with the parallel bars and a sliding lug, suitable electric connection between the lug and a bell in the cab of the locomotive.

585,699. REVERSIBLE PRIMARY BATTERY; L. W. Pullen, Camden, N. J. App. filed Oct. 23, 1896. A reversible primary battery, comprising a suitable cathode, a depolarizing mass in contact therewith, and consisting of a mixture of finely-divided carbon, a salt of manganese and concentrated sulphuric acid uniformly distributed throughout said mixture, and an anode arranged in a dilute electrolyte.

585,707. JOINT OR SPLICE FOR ELECTRIC WIRES OR CABLES AND METHOD OF MAKING SAME; F. Schwedtmann, St. Louis, Mo. App. filed Dec. 14, 1896. The method of forming a joint for electric wires or cables, which consists in forming hooks in the ends of the wire or cable, interlocking the said hooks, and then moulding a conducting metal around the said interlocking hooks.

585,726. ELECTRIC ARC-LAMP; J. J. Walsh, Paris, Tex. App. filed July 29, 1896. A feed-regulator for a carbon-carrying rod of an arc-lamp, comprising a pair of escapement wheels arranged on one shaft, the teeth of one wheel alternating with those of the other, and pendulum-governed escapement dogs alternately coacting with the escapement wheels, the said dogs being mounted to swing independently, one of the other.

585,731. TELEGRAPH SWITCH; J. S. Allen, Halsey, Neb. App. filed July 25, 1896. In a telegraph switch, the combination with contact-pins, of guide-arms, a plunger having a cylindrical portion working in one of the guide-arms, and a flat portion working in the other guide-arm, of a coil-spring for urging the plunger forward, and a contact-plate carried on the end of said plunger, and adapted to normally establish electrical connection between the contact-pins.

585,733. RAILWAY-SIGNALING SYSTEM; H. Bezer, New Rochelle, N. Y. App. filed April 22, 1895. In a block-signaling system for traffic in one direction only, a series of signals arranged in blocks, each intermediate signal of each overlapping group of three signals having locking means controlling the end signals of the group, whereby such intermediate signal locks such end signals at "danger" when it fails to go to "danger" behind a train.

585,746. BRUSH-HOLDER; H. Geisenhoner, Schenectady, N. Y. App. filed Nov. 20, 1896. In a carbon brush-holder, a rotatable stud, one or more brush-holders adapted to be rotated on and adjustably held in fixed position on said stud, and means for adjustably clamping and holding in fixed position said stud.

585,760. ELECTRIC MOTOR FOR ELEVATORS; J. D. Ihlder, Yonkers, N. Y. App. filed Aug. 11, 1896. In an electric motor in which the current through the armature is reversed, a series field in sections, one section of which is reversed with the reversing of the armature.

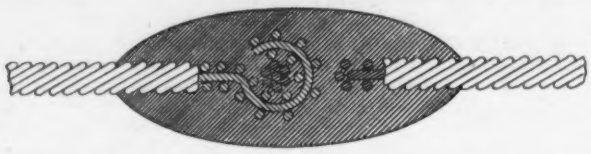
585,772. ELECTRIC CONTROLLER; A. F. MacDonald, Schenectady, N. Y. App. filed Jan. 5, 1897. In an electric controller, the combination of a single set of moving contacts, two sets of brushes mounted for dissimultaneous engagement therewith, the two sets of brushes establishing different circuit combinations of the dynamo-electric machines, and means for changing the relation between the contacts and sets of brushes.

585,853. SECONDARY BATTERY; I. Samuels, New York, N. Y. App. filed Aug. 11, 1896. A secondary battery element comprising a plate of active material, a terminal embedded therein, and a case of conducting material inclosing the plate, the case consisting essentially of two portions, each being perforated and having flanges at its sides and one end, and the two portions moving telescopically within each other, inclosing the conducting-case, except at one end, and permitting of expansion and contraction of the plate.

585,854. GALVANIC BATTERY; J. Sully, New York, N. Y. App. filed Oct. 27, 1896. A galvanic cell composed of a negative, porous, gas-coke, carbon, cylindrical-containing vessel, rendered sufficiently dense on its external surface to prevent the passage onto its surface of an electrolytic fluid

without destroying the porosity of the surface of the vessel or its inner porosity, and a positive zinc pencil immersed in an electrolyte fluid of carbonate of potash and kerosene oil, contained within the carbon vessel, and resting in a small quantity of quicksilver contained within an insulation in the bottom of the vessel.

585,855. GALVANIC BATTERY; J. Sully, New York, N. Y. App. filed Feb. 16, 1897. A galvanic battery cell, composed of a negative, porous, gas-coke, carbon, cylindrical-containing vessel, rendered sufficient dense on its external surface to prevent the passage onto its surface of an electrolytic fluid without destroying the porosity of the surface of the vessel or its inner porosity, and a positive electrode of carbon having pressed against or fast-



No. 585,707.—Joint or Splice for Electric Wires and Method of Making Same.

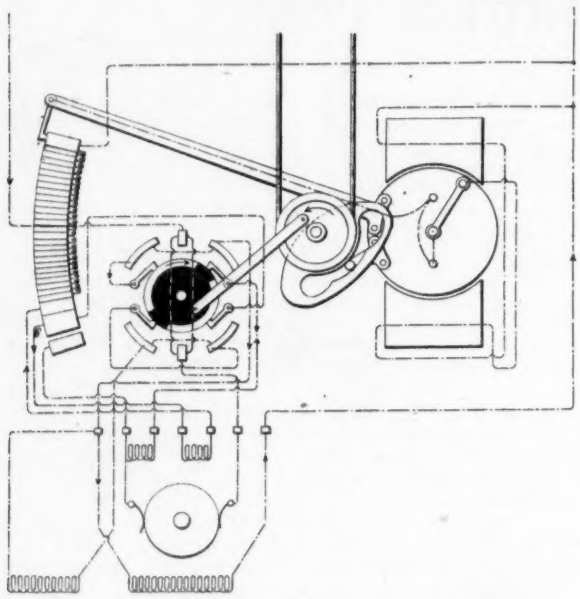
ened to its lower end a section of an easily-oxidizable metal, notably aluminum or zinc, the positive electrode being immersed in an electrolyte, composed of a carbonate of potash, mixed with kerosene oil, contained within the carbon vessel and resting in a small quantity of quicksilver contained within an insulation in the bottom of the vessel.

585,863. ARMORED ELECTRICAL CONDUIT; E. T. Greenfield, Brooklyn, N. Y. App. filed Oct. 7, 1896. A conduit having an external metallic armor, an internal tube or lining of insulating material and an interposed layer of fibrous material which is impervious to moisture.

585,864. ARMORED ELECTRICAL CONDUIT; E. T. Greenfield, New York, N. Y. App. filed Dec. 10, 1896. A conduit tube composed of a metal armor and an interior lining of oilcloth, with the painted surface thereof adhering to the inner wall of the armor.

585,872. BRUSH HOLDER FOR DYNAMO-ELECTRIC MACHINES; R. Lundell, Brooklyn, N. Y. App. filed July 11, 1896. A commutator brush-holder provided with two sets of adjusting devices, one of which sets of adjusting devices tends to give to the brush downward pressure against the commutator, and a lateral or side pressure against the stationary part of the holder, and the other gives to all of said parts vertical adjustment, so as to adapt the entire structure for brushes of various lengths.

585,892. ELECTRICITY METER; A. W. Staveley, I. H. Parsons and T. J. Murday, Leicester, England. App. filed Jan. 5, 1897. In an electricity meter, the combination with an ammeter provided with an indicating-arm, operated thereby, of recording mechanism, an operating-lever for said re-



No. 585,760.—Electric Motor for Elevators.

cording mechanism provided with an arm or feeler having a portion in the path of said indicating-arm, for regulating the position of said lever, and an actuating device having a uniform movement adapted to engage said lever.

585,896. TELEPHONE TRANSMITTER; E. C. Wilcox and B. L. Lawton, Meriden, Conn. App. filed Aug. 31, 1896. In a telephone transmitter, the combination with a chambered head formed with two forwardly projecting lugs, of a carrier-arm having its inner-end inserted between the said lugs, a pivot passing through the lugs and arm for pivotally connecting the latter with the former, and one or more friction springs interposed between the arm and lugs for holding the arm in any desired position of adjustment, and for improving the electrical connection between the arm and head, the inner end of the said arm and the said lugs being constructed and adapted for the interposition of one or more friction-springs between them, and the said metal springs having constant positive contact with both the arm and the lugs, independently of the pivot.

585,904. AUTOMATIC CUT-OUT; C. N. Black, New Haven, Conn. App. filed March 15, 1897. The combination with a dynamo-electric machine having two or more independent armature circuits, of two or more independent lamp-circuits connected in series with and between the independent armature circuits of the machine, and automatic cut-outs corresponding in number to the independent lamp-circuits, which they are placed across, and each providing a non-inductive path and operating to instantaneously short-circuit the respective lamp-circuits when the voltage therein exceeds a predetermined safe-working limit.

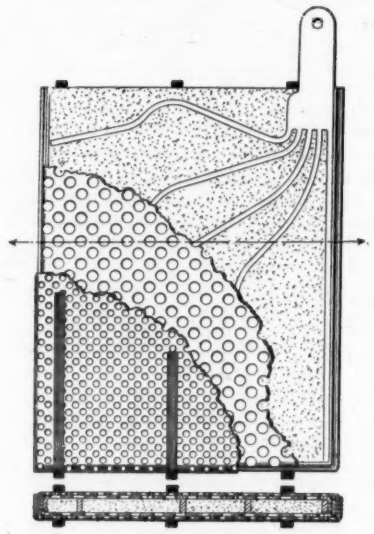
585,915. OPERATOR'S SWITCH FOR TELEPHONE EXCHANGES; L. Johnston, La Crosse, Wis. App. filed March 13, 1897. In an electric circuit-changing mechanism, the combination with a non-conducting cam having a series of recesses in its working face and teeth or projections between said recesses, of a series of pairs of contacts arranged one in advance of the other in a plane parallel with the said working face; one member of every pair at the same side of the series normally tending to spring away from its opposed mating member and toward the said working face of the cam, whereby as the cam is moved predetermined distances certain of said contacts will spring into the cam-recesses, and certain others will be moved into contact with their mates to make and break the determined circuits.

585,937. ELECTROMAGNETIC AND MECHANICAL BRAKE; J. E. Parker, Bayonne, N. J. App. filed Dec. 17, 1895. In an electromagnetic and mechanical brake, and in combination, an electromagnetic brake-bar and blocks placed horizontally in juxtaposition to car wheels, and a metal frame supporting said bar and blocks, engaging with a shaft placed transversely across the car, and having a screw thread at each extremity, and controlled by hand by means of a sprocket cylinder and sprocket chains, causing the brake-block to advance or retreat in respect to the inner surface of the car wheels.

586,029. ELECTRIC SWITCH; F. D. Hall, Syracuse, N. Y. App. filed March 8, 1897. The combination with an insulating base and a plurality of poles secured to said base and disposed in pairs, of a tubular post projecting from the base between the pairs of poles, a plunger guided rectilinearly in said post, switch-plates carried by said plunger permanently parallel with the respective pairs of poles, a lever fulcrumed in the post, an eccentrically curved cam fixed to said lever, and bearing on the end of the plunger to force the same toward the base, means for locking the lever to retain the switch-plates in contact with the poles, and a spring in the base of the post forcing said plunger outward.

586,044. ELECTRIC STORAGE OR SECONDARY BATTERY; F. King, London, England. App. filed Jan. 26, 1897. A secondary battery element consisting of a plate or support having perforations therethrough containing active material or material to be rendered active, and having applied to the sides thereof an adherent coating or membrane of india-rubber, perforations being made through the rubber and through the active material, so that the electrolyte may have access to the active material through said perforations, the faces of the plate being protected from contact with the electrolyte by the adherent coating of rubber.

586,055. MANUFACTURE OF INCANDESCENT LAMPS; J. W. T. Olan, New York, N. Y. App. filed March 11, 1893. The process of manufacturing an incandescent lamp which consists in arranging within a solid enclosure an electrically-conducting filament, foil or body, adapted to become incandescent by an electric current, introducing liquid alkali metal composition into said inclosure, so as to fill the same, sealing the inclosure except at the exit for the liquid alkali metal composition, removing the composition from said inclosure in such a way as to form a barometric vacuum therein, and finally hermetically sealing the inclosure.



No. 585,853.—Secondary Battery.

586,075. ELECTRIC SWITCH; E. Oxley, Washington, D. C. App. filed April 23, 1897. In a balanced system of electrical distribution the combination with the balancing-wire, of a switch normally closed against spring pressure, and completing the circuit upon all sides of the system, an electromagnet having a winding of comparatively high resistance connected to the opposite sides of the fuse of the balancing-wire, and an armature for said magnet connected to a device which mechanically locks the switch in its closed or "on" position.